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Electronic Business®

Top employers in the U.S. electronics industry PAGE 28

Asian issues reshape the PCB equipment industry PAGE 78

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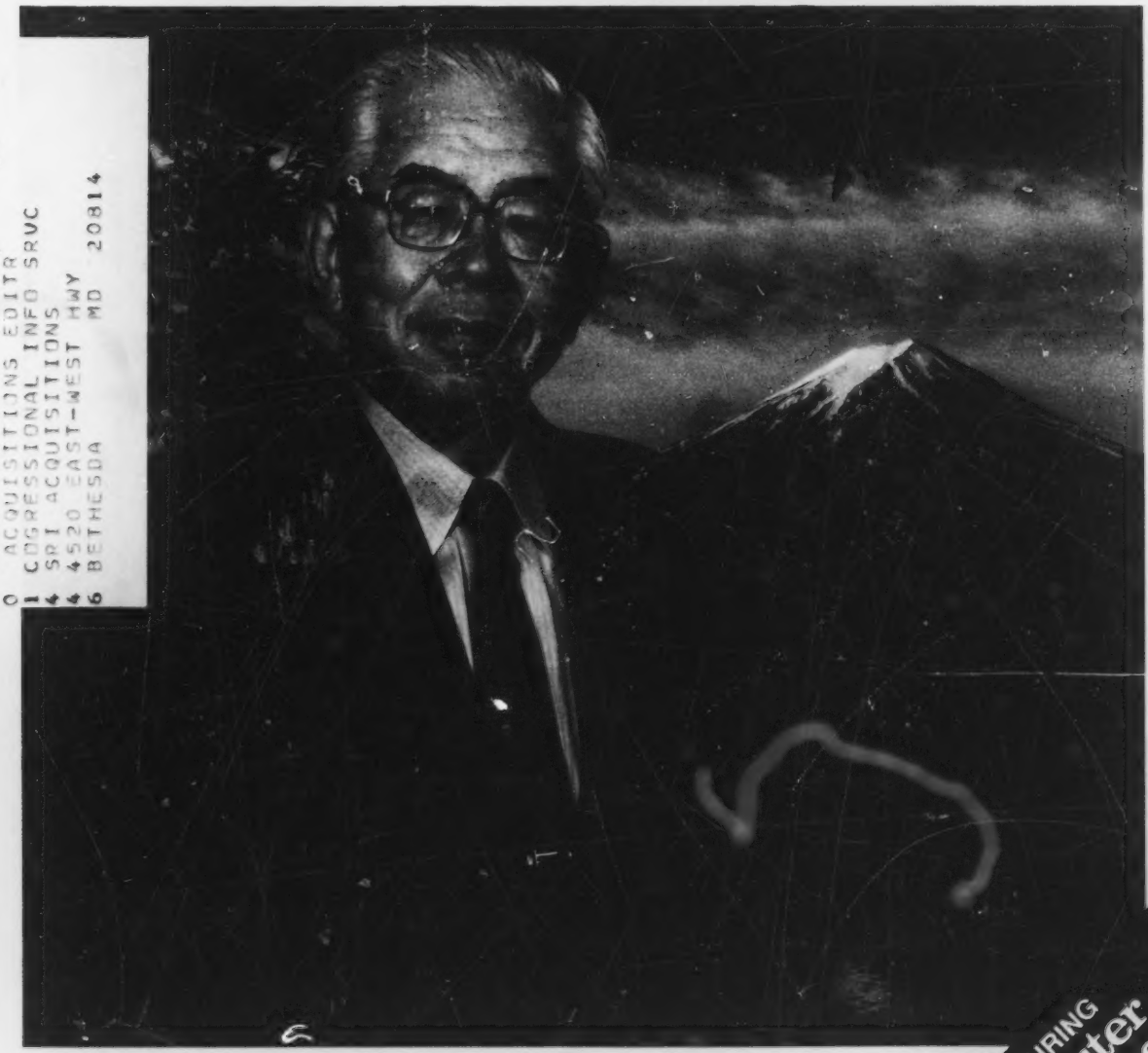


Tadahiro Sekimoto: Philosopher-president of NEC's sprawling Japanese empire PAGE 40

FEATURING Computer Business PAGE 55

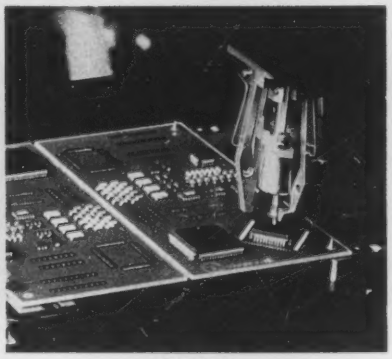
Electronic Business

VOL. 13, NO. 18 SEPTEMBER 15, 1987

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES

PAGE 28

PAGE 40



PAGE 78

BUSINESS TRENDS

28 Fewer jobs and higher productivity in electronics
The white-collar productivity is increasing even as electronics firms trim their employment rolls.

34 A three-way battle for high-performance control
Only three companies make peripheral controllers that match the high-performance needs of workstations and minisupers.

36 Diversification is the buzzword in Kuala Lumpur
Burned by the chip slump, Malaysia now wants to go beyond IC assembly and move into other areas of electronics.

EXCELLENT COMPANIES

93 Excellent companies
Our readers choose the best companies in the electronics industry.

PRODUCTIVITY

108 Analog Devices: Quality from the bottom up
Analog president Ray Stata started the quality ball rolling, but the real action began when manufacturing became involved.

MANAGEMENT

40 NEC takes the Triple Crown in electronics
Call it the "three Cs." Under Tadahiro Sekimoto, NEC is 1st in chips, 5th in computers and 5th in communications.

COMPUTER BUSINESS

55 Database applications spur the CD-ROM market
So far, only niche databases are available, but the arrival of general-interest ones could boost drive sales.

56 Tape drive? Minicomputer? Coming right up, sir
Alongside chips, distributors now offer computer products galore. One day they might even make money at it.

64 The Year of the Rabbit and the 3.5-inch Winchester
This year, for the first time, low-end 3.5-inch disk drive shipments are expected to exceed 5.25-inch models.

72 From Gutenberg to PageMaker in five easy centuries
The market for corporate electronic publishing systems is just getting under way in Europe but prospects are promising.

AN EDITORIAL INDEX OF ALL COMPANIES DISCUSSED IN THIS ISSUE CAN BE FOUND ON PAGE 122

PCB EQUIPMENT

78 Dynapert and Universal go for the Asian gold
The largest manufacturers of PCB assembly gear are shifting their perspective to include the Far East.

81 The lure of the low-end board test market
Competition is making medium-sized ATE companies look to the low end of the printed circuit board test market.

82 Upward mobility in circuit board design
Workstation price wars are making PCB CAD vendors seek alternative hardware solutions at the low end.

DEPARTMENTS

4 Inside Business

9 Update

17 Business Barometer: Teaching an old component new tricks.

24 Letters

11[illegible] Comment: Finding ways to improve Sino-American trade.

116 Calendar

122 Editorial Index

124 Viewpoint: Big business and the geopolitics of risks.

Photograph of Tadahiro Sekimoto, courtesy NEC; background photograph, Mike Yamashita/Woodfin Camp

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BPA ABP

ASPCs: Teaching an old component new tricks

Application-specific passive components may do for passives what ASICs did for silicon chips

Managers of U.S. companies that make nonsemiconductor components of all types (capacitors, discrete semiconductors, ICs, magnetic components, resistors and others) have taken a page from their U.S. colleagues in the semiconductor business. They no longer expect much growth from their standard product lines. Instead, these managers look to add value to those products and solve applications problems for their customers; something akin to what application-specific ICs do in the semiconductor business. If successful, they look to expand their business by more than the 5% growth that the Electronic Industries Association is forecasting for this year in passive components.

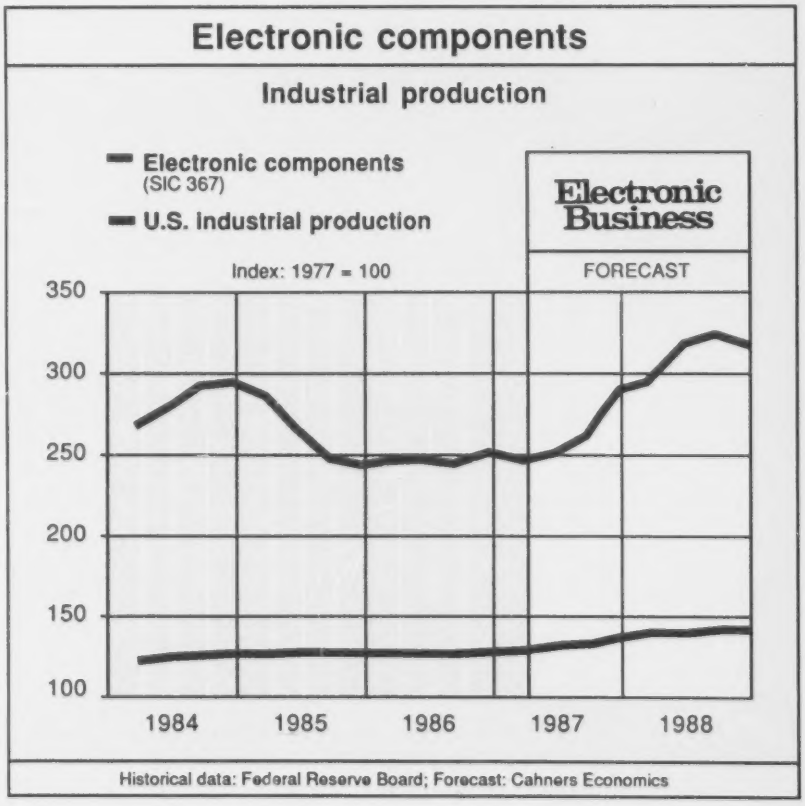
After two years of declining and stagnating production of components in the United States, the application-specific component business provides a ray of hope. According to Federal Reserve Board data, the dollar value of U.S. production for SIC 367 (electronic components of all types, including semiconductors) peaked in the fourth quarter of 1984, almost three years ago. A year later, it had dropped by almost 20%, and it hasn't since picked up significantly. But in this quarter it may do so, according to the forecast by Cahners Economics. In fact, Cahners expects the second half to lift this year's SIC 367 production by 7% over 1986, and says it will end this year just short of the 1984 peak.

Although the FRB data does not separate semis from other components, most of the decline can be traced to U.S. semiconductor production. Likewise, semis are expected to bear most of the recovery. But the makers of nonsemiconductor components also saw their markets shrink, if not in units, certainly in dollars. Howard F. Wasserman, president of Unitrode Corp., a Lexington, Mass., company that splits its $150 million in sales almost equally between discrete semiconductors on the one hand; and capacitors, hybrid circuits and switching power supplies on the other; explains the price pressures on one of his passive components. U.S. suppliers of commercial axial-leaded ceramic capacitors, he says, "sold about the same number of units in the first quarter of this year as were sold in the first quarter of 1984. Yet, the dollar value of those units is less than 75% of what it was three years earlier."

Wasserman wants to maintain market share in capacitor units, and hopes to even gain slightly in dollars by increasing quality and service. But he pins his hopes for growth on new products built around his current components but aimed at two applications: filters and switching power supplies.

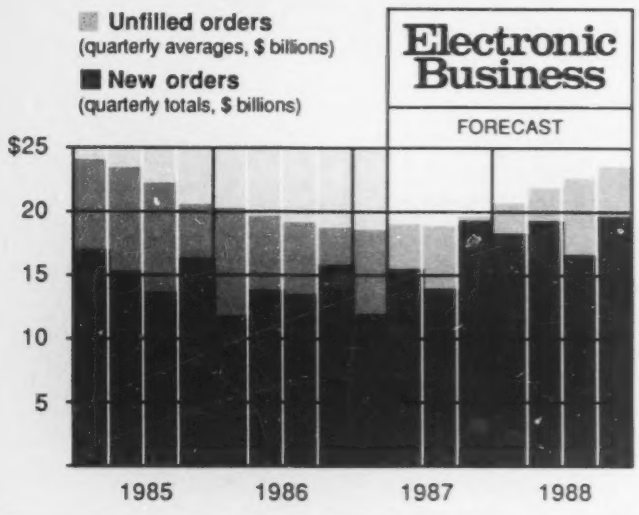
AVX Corp., a Great Neck, N.Y., components maker whose sales of multilayer ceramic capacitors alone almost equal Unitrode's total revenue, is pursuing a similar strategy in the same markets. AVX's Olean Advanced Products Division, says chairman Marshall Butler, "sells filter components that allow AMP or Molex to take a $5 connector and make it into a $15 filter connector."

ALBERTO SOCOLOVSKY

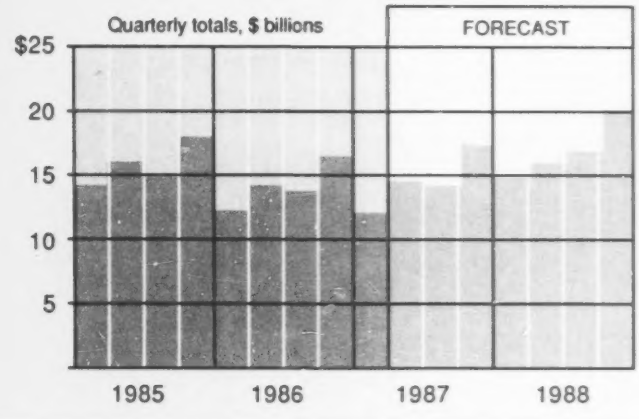


Office and computing equipment (SIC 357)

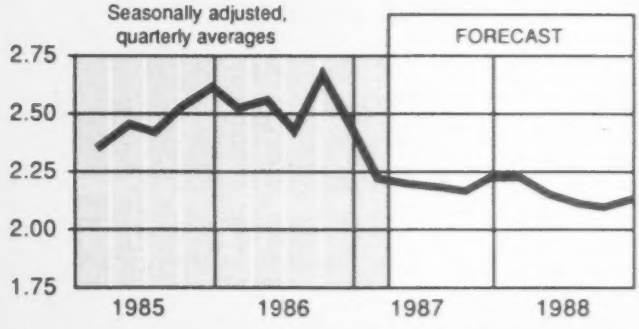
New and unfilled orders



Shipments



Inventory-to-shipment ratio



Historical data: U.S. Commerce Department; Forecast: Cahners Economics

New orders
Rising a steady 2.6% above year-ago levels, new orders for office and computing equipment stood at $11.9 billion in the first quarter of 1987. Continued strength in orders for April and May of this year point to a strong second-quarter showing as well. Increased spending for microcomputers, minis and workstations is the impetus behind this surge. In fact, the business cycle upturn for computer orders is now in full swing. Improved corporate balance sheets will fund even more machinery investment in 1988. Coupled with gains in export markets, domestic manufacturers are expected to see an 11% rise in orders by the end of this year and a 21.6% surge in 1988.

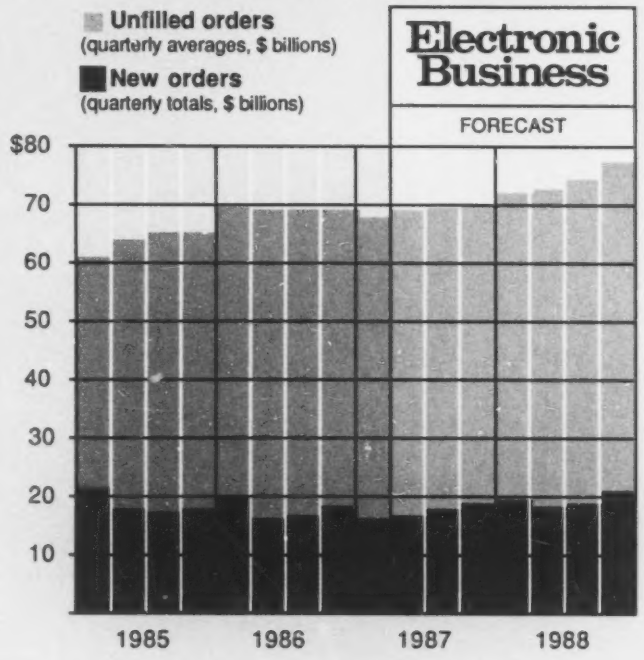
Shipments
The rise in orders is just beginning to translate into an increase in office and computing equipment shipments. In the first quarter of 1987, shipments actually fell 2.3% below year-ago levels. But early evidence from the second quarter of 1987 shows that shipments are on the rise. Indeed, in May, manufacturers shipped about $4.42 billion worth of equipment, an increase of 10.9% over April and 6.1% over May 1986. Shipments are expected to rise even faster in the third quarter. By end of the year, shipments are likely to hit $57.8 billion, a 2.8% annual gain. In 1988, expect shipments to grow 17.0%.

Unfilled orders
Manufacturers backlogs fell to $18.5 billion by the end of the first quarter of 1987. January's backlog of $80.1 billion, was the lowest level of unfilled orders in four and a half years and was 25.2% below the previous backlog peak of $24.2 billion set in June of 1984. A pickup in orders is expected to spark a gradual increase in backlogs by the fourth quarter of this year and into the beginning of next year. Not until the fourth quarter of 1988 are office and computing equipment backlogs expected to rise above $23 billion again.

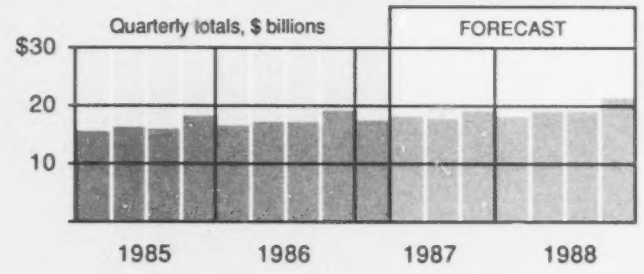
Inventory-to-sales ratio
With the rapid depletion in backlogs, inventory of office and computer equipment fell over $2 billion in early 1987 compared with the year-ago period. From a previous high of 2.71 set in January of 1986, the inventory-to-sales ratio fell to a low of 2.02 11 months later. Since then, the inventory-to-sales ratio has fluctuated, rising to 2.17 in March and falling to 2.06 in May. Rising shipments and a tight inventory policy influenced by post-recession psychology will keep the ratio below 2.2 throughout the next year.

Communication equipment (SIC 366)

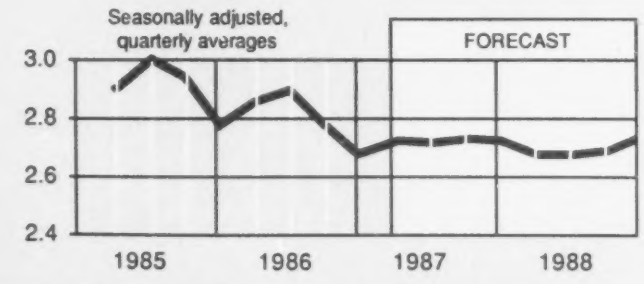
New and unfilled orders



Shipments



Inventory-to-shipment ratio



Historical data: U.S. Commerce Department; Forecast: Cahners Economics

New orders

Communication equipment manufacturers received $16.4 billion in new orders during the first quarter of 1987, a drop of 13.4% from the prior quarter and 18.9% from the year-ago period. A slackening in military procurement obscured the fact that bookings for nondefense communication equipment have improved. The current rebound in the nondefense segments, plump order backlogs, and a likely pickup in DOD spending on C^{3}I programs later this year make the near-term market outlook less grim than the recent bookings data suggest. Quarterly orders are expected to turn around in the second quarter of this year. But, the improvement will not be enough to prevent 1987 from posting a loss of 3.3%. However, a healthy 11.9% increase is expected in 1988.

Shipments

Manufacturers shipped an estimated $17.4 billion worth of equipment in the first quarter of 1987, down 8.9% from the previous quarter. However, on a year-to-year basis, shipments were still up 6.3%. Except for the traditionally slow summer quarter, shipments are expected to edge up for the rest of 1987 and through 1988. For the year, shipments are expected to climb 4.2% to $72.6 billion. Next year, an increase in the nondefense industries will push shipments up approximately 6.9%.

Unfilled orders

Order backlogs in the communication equipment industry averaged $68.9 billion in the first quarter of 1987, a dip of 0.7% from the average in the previous quarter. Projections are for backlogs to remain relatively flat during 1987, showing only 1% or 2% annual growth. By year-end 1988, backlogs are expected to expand 10% to $77.6 billion.

Inventory-to-shipment ratio

The ratio of manufacturers' inventories to shipments averaged 2.72 for the first quarter of 1987, up from the reading of 2.68 for the prior three-month period. Projections indicate that the ratio will hover at the first quarter proportion for the remainder of 1987 and drop slightly through most of 1988 as manufacturers continue to maintain disciplined inventory controls.

LABOR PRODUCTIVITY

Fewer jobs and higher productivity in electronics

White-collar productivity is increasing even as electronics firms trim their employment rolls

Ever since the U.S. electronics industry soured in late 1984, total employment has been steadily declining. Now, as the economic tide begins to turn and demand picks up, there are indications that employment growth will be slower than production growth. The bright side of the picture is that labor productivity is improving.

Based on research conducted by ELECTRONIC BUSINESS, employment in the top 25 electronics companies declined slightly — from a total of 1.916 million people in 1985 to 1.901 million in 1986. In fact, all but six companies on the ELECTRONIC BUSINESS list of the top 25 employers suffered some degree of employment contraction during the 1985-1986 time frame. Figures from the American Electronics Association (AEA) show the same trend: at the end of 1984, there was a peak of 2.59 million U.S. electronics industry employees — by March 1987, 120,000 had left the industry.

At the same time, average labor productivity improved for both the top 25 corporations and the industry as a whole. Between 1985 and 1986, revenue per employee for the top 25 increased 6.4%, from $87,930 to $93,589. Also, industry shipments per employee grew 1.4%, from $88,931 to $90,208.

For most of the top 25 electronics companies listed here, reductions in employment and productivity improvements are a response to both softening markets and various long-term shifts in business strategy. In general, many firms are restructuring; automating away from production-line jobs; moving offshore; and paring down middle- and upper-level management layers.

The Singer Co. was the biggest restructuring offender, in percentage terms. It shed its famous sewing machine division and other commercial lines in order to concentrate on aerospace and electronics. In total, Singer dropped 18,000 people, or 39% of its workforce, last year. Similarly, Honeywell Inc. sent 16,000 people packing as it realigned itself.

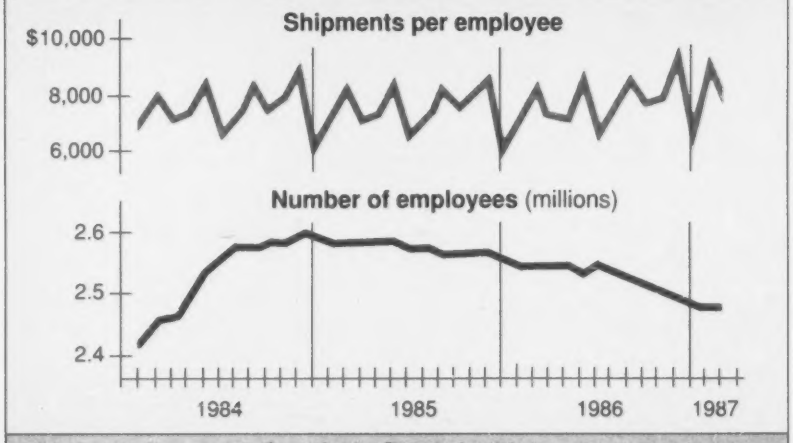
Comparatively, AT&T's job loss through restructuring almost equaled that of Singer's and Honeywell's combined. AT&T slashed 32,000 employees from its payroll in 1986 as a result of consolidation — partly as the result of its poor performance in the computer market. But chairman James Olsen is adamant about two things: R&D and capital investment. Like many of its competitors, the number two-ranked electronics giant is looking to become more capital intensive.

At the same time, the semiconductor industry has been caught in a major structural shift toward more capital-intensive production as it tries to stave off foreign competition. Intel Corp. and National Semiconductor Corp. cut their workforces by 3,100 people and 6,300 people, respectively. The exception was Motorola Inc. that increased workforce in 1986 by 4.7%.

The Bureau of Labor Statistics (BLS) of the U.S. Department of Labor, reports that the U.S. semiconductor industry eliminated 11,000 jobs between 1985 and 1986; component manufacturers cut 19,000 jobs; and the computer industry, 34,000 jobs. Even though the BLS sees employment rebounding this year, it will be at a more measured pace than the frenetic growth experienced in the late 1970s and early 1980s.

Ronald Kutscher, associate commissioner in the Office of Economic Growth and Employment Projections at the BLS, believes that 1986 was a shakeout year for the industry and that employment growth will begin to taper. By the end of the century,

Labor productivity in the U.S. electronics industry remains high, as employment declines



Source: American Electronics Association

Marty Braun

Half of all workers in IC plants are white collar

Top 25 electronics employers

Fiscal 1986 figures

Rank	Company (EB 200 rank)	Number of employee (thousands)	Change from 1985	Revenue per employee ($ thousands)	Change from 1985	Profits per employee ($ thousands)	Change from 1985	Revenue ($ millions)	Profits ($ millions)	Fiscal year ended
1	**IBM** (1)	403.5	-0.5%	$127.0	2.9%	$11.9	-26.6%	$51,250.0	$4,789.0	12/86
2	**AT&T** (2)	316.9	-6.1%	107.6	-35.6%	0.4	-90.5%	34,087.0	139.0	12/86
3	**GM Hughes Electronics** (4)	102.0	-2.9%	102.4	13.1%	4.4	-6.3%	10,440.0	445.1	12/86
4	**Xerox** (6)	100.4	-2.0%	93.2	9.3%	4.9	30.8%	9,355.0	488.0	12/86
5	**Unisys** (7)	96.0	—	77.4	—	-0.5	—	7,432.4	-43.4	12/86
6	**DEC** (5)	94.7	6.4%	80.2	6.7%	6.5	29.9%	7,590.4	617.4	6/86
7	**Motorola** (11)	94.4	4.7%	62.4	3.4%	2.1	157.5%	5,888.0	194.0	12/86
8	**Hewlett-Packard** (8)	82.0	-2.4%	86.6	11.8%	6.3	8.1%	7,102.0	516.0	10/86
9	**Honeywell** (12)	78.1	-16.9%	68.9	-2.3%	0.2	-94.4%	5,378.2	12.9	12/86
10	**Texas Instruments** (13)	77.3	-0.8%	64.4	1.8%	0.5	NM	4,974.0	39.9	12/86
11	**NCR** (14)	62.0	0.0%	78.7	13.1%	5.4	6.8%	4,881.6	336.5	12/86
12	**N.A. Philips** (18)	50.4	-2.7%	89.9	6.0%	1.4	-13.6%	4,531.6	68.5	12/86
13	**Zenith Electronics** (34)	37.0	12.1%	51.1	3.9%	-0.3	15.8%	1,892.1	-10.0	12/86
14	**Tandy** (19)	36.0	2.9%	84.3	3.9%	5.5	1.6%	3,035.7	197.7	6/86
15	**Control Data** (21)	34.4	-11.4%	97.3	2.7%	-9.0	NM	3,346.7	-311.1	12/86
16	**Wang Laboratories** (22)	31.6	1.8%	83.5	10.4%	1.6	222.5%	2,642.5	50.9	6/86
17	**National** (39)	30.8	-17.0%	48.0	-0.4%	-4.8	NM	1,478.1	-148.3	5/86
18	**Pitney Bowes** (36)	29.2	0.6%	68.1	7.8%	5.7	14.2%	1,986.7	166.1	12/86
19	**Singer** (41)	28.0	-39.1%	62.6	19.1%	2.1	16.8%	1,752.2	58.5	12/86
20	**Harris** (29)	26.7	-15.0%	83.0	14.3%	2.2	-12.7%	2,216.6	59.6	6/86
21	**AMP** (40)	21.8	-4.4%	88.7	23.6%	7.5	59.1%	1,933.1	164.3	12/86
22	**Intel** (48)	18.2	-14.6%	69.5	8.5%	-10.1	NM	1,265.0	-183.3	12/86
23	**Tektronix** (44)	17.4	-15.5%	78.2	11.6%	2.3	-48.4%	1,357.2	39.3	5/86
24	**General Instrument** (57)	16.3	-20.5%	48.3	24.8%	1.1	NM	787.9	18.5	2/87
25	**Data General** (46)	15.6	-5.9%	81.5	8.7%	-1.9	NM	1,268.0	-29.0	9/86

NM = Not meaningful

Source: ELECTRONIC BUSINESS

Kutscher predicts that the computer, semiconductor and component workforce will grow more modestly, employing 1.14 million people by 2000, up from about 1 million people for those segments in 1986.

Kutscher says that part of the reason for the high-tech job slowdown is that the makeup of the U.S. electronics laborforce is changing. The low-skilled subassembly work will continue to flow offshore, while the U.S. electronics industry will focus on high-skill design and prototype work.

There is also a shift in electronics from direct production to indirect — often white-collar — labor. For example, the U.S. Department of Commerce reports that between 1974 and 1984 the percentage of production workers in the semiconductor segment plunged to 49% of the total semiconductor workforce, from 61%. In computers, the comparable figure dropped from 49% to 41.5% and in electrical instruments, from 60% to 53.4%.

Ken McGill, an senior economist with Wharton Econometrics in Bala Cynwyd, Pa., is forecasting the labor productivity growth rates in the semiconductor and component industries to pick up in the next 10 years as both segments become more capital intensive and the makeup of the workforce changes. But McGill argues that because of the increasing foreign labor content in many U.S. products, domestic labor productivity is being overestimated. Measurements need to be changed for U.S. labor productivity because they do not account for the growing amount of foreign labor in U.S.-made goods, he says.

Capital ideas

The shift toward indirect labor indicates that direct labor is becoming virtually insignificant as a percentage of a typical product's total cost. Some companies, in fact, claim it may be as low as 2%. As a result, the focus of attention may be turning to indirect labor productivity — improving management and capital productivity, for example.

This may be a good thing. Since the beginning of the decade, U.S. capital investment has been stagnant. Overcapacity, overinvestment and slack demand has kept companies from buying new plant and equipment, and shelling out for research and development. As a result, capital productivity has suffered.

According to the American Productivity Center (APC), a Houston-based research and consulting firm, capital productivity in U.S. private businesses hit rock bottom in mid-1982 and has only slightly improved since. As demand improves, APC says, so will capital productivity. But capacity utilization is still hovering around 70% and is not under any serious pressure to increase. As a result, capital investment remains weak.

Robert Eggert, economist and president of Eggert Enterprises in Sedona, Ariz., and editor of *Blue Chip Economic Indicators*, a newsletter that reports forecasts of top U.S. economists, says that over the last six months he has seen a turnaround in capital spending. This has been stimulated mainly by the drop in the value of the dollar which is, in turn, stimulating overseas demand for U.S. products.

THE BIGGEST GAINS in productivity can be achieved by making white collar workers more efficient

Priscilla Luce Trumbull, senior economist and director of industrial services at Wharton Econometrics is not as sanguine. She believes that there will be a slight uptick in capital investment later this year. During 1986, capital investment was very bumpy largely because of the Tax Reform Act of 1986. "We haven't seen a significant improvement yet, but we are expecting it to pick up soon," she says.

Despite the sluggishness of capital investment, Trumbull believes that much of the investment that has been made over the last two years was geared toward enhancing labor productivity rather than expanding facilities and building new plants. Factory-floor computer systems, automated testing equipment and materials-handling equipment all contribute to improved labor efficiency and productivity. If traditional capital investment stays low, as it is expected to do, then this productivity kind of capital investment will no doubt continue and become more significant.

Just-in-time manufacturing — getting components to the factory floor just in time for production — is one low-capital technique that is contributing to improvements in labor productivity. Mostly JIT involves long-term investment in changing management attitudes and strategies, rethinking production techniques, and focusing on quality control.

International comparisons

But, even though domestic labor productivity is improving, foreign labor productivity often improves at a faster rate. The BLS, estimated that in 1985, U.S. manufacturing labor productivity increased by 4.4%, while Japan's rose by 5% and West Germany's by 5.6%. Japan is at the top of the list in manufacturing labor productivity growth between 1982 and 1985 while the U.S. ranked eighth. And, in electrical machinery, the American Productivity Center says that Japan's productivity growth was five times greater than America's between 1980 and 1983.

In 1986, Japan's top 20 electronics firms reported labor productivity of $267,100 sales per employee, but the top 20 U.S. firms reported only $88,700 [ELECTRONIC BUSINESS, April 1, p77]. Although the weakening dollar is providing some respite from offshore competitive pressure, the U.S. government's huge capital requirements caused by the federal budget deficit may ensure that the dollar will not fall further.

As foreign demand for U.S. goods increases, the renewed energy that foreign countries will place on productivity improvements in their export industries will offer future challenges to U.S. manufacturers. This is hardly a cause for celebration in domestic industry, particularly electronics. The best that can be expected, most experts say, is a continued steady upward trend.

BRUCE C.P. RAYNER and
LINDA STALLMANN

Marty Braun

SOUTHEAST ASIA

Diversification is the word in Kuala Lumpur

Burned by the chip slump, Malaysia now wants to go beyond IC assembly and move into other areas of electronics

Malaysia, the chip-assembly capital of Southeast Asia, is looking for ways to diversify its electronics industry.

Jobs have a lot to do with it. American-owned electronics subsidiaries employed 35,900 Malaysians last year, slightly more than they did in 1985, but still down about 8,000 jobs from their peak year in 1984. Admits N. Sadasivan, director general for the local Industrial Development Authority: "Our value-added is minimal, less than 2% to 3% of the total output. If we achieve improvements in that, we will be more than satisfied."

Sadasivan is betting that the 2-year-old Malaysian Institute of Microelectronic Systems, or MIMOS, will help to pump up the industry. MIMOS is an R&D lab for the use of companies operating in Malaysia.

The government's strategy is to get foreign companies to make more finished products in Malayaia. Also, Sadasivan wants to build on the chip assembly foundation by attracting more front-end chip manufacturing. Already National Semiconductor Sdn. Bhd. is doing so. To encourage all of the above, the government founded MIMOS in Kuala Lumpur.

Staffed by 40 engineers and with an annual budget of a couple of million dollars, MIMOS offers six courses a year in electronic design. MIMOS director general Tenku Mohd Azzman Shariffadeen, originally an academic, got tired of seeing his students get jobs as equipment operators in foreign-owned assembly plants.

In addition to government funding, MIMOS has received money from LM Ericsson Telephone Co., GEC Plc and NEC Corp. GEC will be the first to show commercial fruits from its venture, Shariffadeen says, with a MIMOS-designed telecom chip for its Marconi Italiana SpA subsidiary. The British Marconi got a big order last year from the Malaysian Telecommunications Authority for pulse code modulators and telephone multiplexers, which might have encouraged the MIMOS relationship. Likewise, Shariffadeen says NEC just wanted to be a "good corporate citizen" with its half million dollar donation, but he hints that products are in the works, as well.

MIMOS also has a charter to de-

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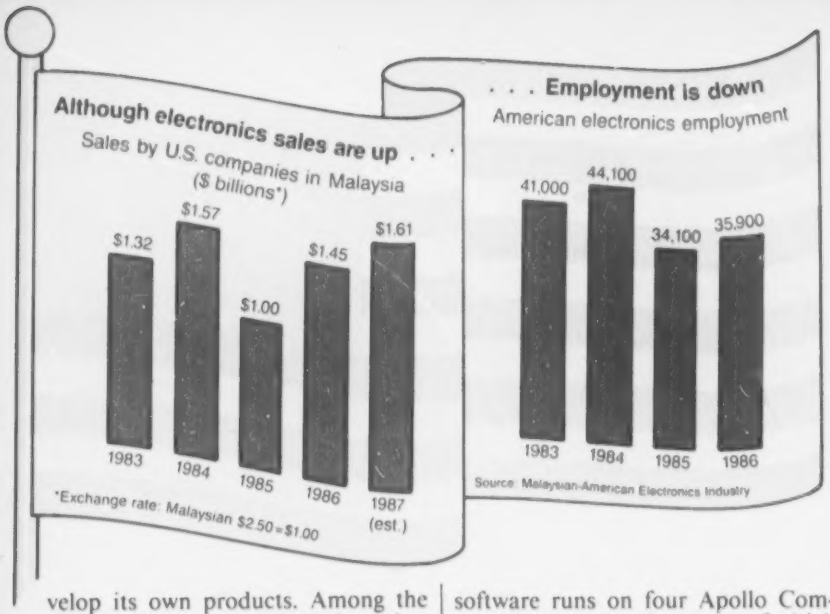

velop its own products. Among the first will be a single-board, under-$1,500 computer to be marketed by a local company.

Although MIMOS had to first turn to Sweden for its electronic design software — the United States was embargoing Malaysia at the time —it now uses systems from Mentor Graphics Corp., purchased through Malaysian universities. The design software runs on four Apollo Computer Inc. workstations, one of which was donated by GEC. MIMOS also has a handful of Sun Microsystems Inc. workstations donated by Australia, and a supermini purchased from Digital Equipment Corp.

The dozen U.S. electronics companies in Malaysia made up over half of the country's $2.6 billion industry in 1986, and should have sales of $1.6 billion this year, according to the Malaysian-American Electronics Industry, the local trade organization. So far, none of those companies has availed itself of MIMOS' services.

Most of them agree with MAEI chairman Roger Bertelson, managing director of Motorola Semiconductor Sdn. Bhd., who says that "circuit design is still going to come from being close to the customer base" — namely, back in the United States. "Chip design, that's out of my line," adds Russell Smith, managing director of RCA Sdn. Bhd. He says that his personnel in Malaysia are in manufacturing.

One company that has used MIMOS, however, is Accent Technology Sdn. Bhd., a Malaysian-owned maker of IBM personal computer clones. Chief executive Larry Risser says that he should be cranking out PCs at the rate of 800 a month by the year's end. He is producing 300 a month now, partly for government contracts to the state-run airline and the national electric power agency.

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MULTINATIONALS

NEC takes the Triple Crown in electronics

Call it the "three Cs." Under Tadahiro Sekimoto, NEC is 1st in chips, 5th in computers and 5th in communications

By Alden M. Hayashi

Call it the Triple Crown in electronics. Or call it the grand slam of the industry. But whatever you call it, NEC Corp. of Tokyo is the only company to achieve it.

With sales of $16.8 billion last year, NEC alone ranks among the top 10, worldwide, in the three most important markets of the electronics industry: chips, computers and communications. The company is No. 1 in semiconductors, fifth in data processing and fifth in telecommunications equipment. No other company, not even IBM, can make that claim.

"IBM's computer sales are maybe 10 times more than NEC's. And AT&T's communications sales are about three times more than ours .... But we are the only company ranking in the top 10 in all three areas," boasts Tadahiro Sekimoto, NEC president for the past seven years.

An animated speaker, Sekimoto often sketches charts and graphs to illustrate his points, a trapping of his Ph.D. training in engineering. But he is not just a numbers man. Prone to lengthy philosophical discussions, he enjoys chatting about how NEC's marriage of the computer and communications technologies, or "C&C" as the company's slogan has it, will help better society and improve world peace. And help NEC retain its Triple Crown.

The ultimate goal of NEC, says Sekimoto, is the creation of "artificial servants" to serve man. Such advanced robots, he says, will have computers for brains, software for intelligence, communications technology for nervous systems, peripherals (such as disk drives) for their five senses, and semiconductors for tissue. Because of NEC's mastery of chip, computer and communications technology, the company is uniquely positioned to develop such artificial servants for the 21st century, claims Sekimoto.

He and chairman Koji Kobayashi are NEC's technology visionaries. Both foresee the day sometime early next century when NEC will perfectly unite computers and communications by developing a computerized telephone translator product. A user of such a system will be able to talk into a phone in one language and be heard in another.

In addition to foresight, Sekimoto lists NEC's three other management precepts: execution, perseverance and flexibility. Indeed, it is NEC's flexibility that is helping the company

NEC ranks among the top 10 worldwide in...

Semiconductors

1986 production ($ millions)

1	**NEC**	$2,560
2	**Toshiba**	2,270
3	**Hitachi**	2,160
4	**Motorola**	1,960
5	**Texas Instruments**	1,850
6	**Philips***	1,325
7	**Fujitsu**	1,145
8	**Matsushita**	1,145
9	**Mitsubishi**	990
10	**National**	970

* Includes Signetics

Source: Integrated Circuit Engineering Corp.

Computers

1986 sales* ($ billions)

1	**IBM**	$47.6
2	**Unisys**	9.4
3	**DEC**	8.4
4	**Fujitsu**	6.0
5	**NEC**	5.6
6	**Hitachi**	4.6
7	**NCR**	4.2
8	**Hewlett-Packard**	4.2
9	**Olivetti**	3.7
10	**CDC**	3.3

* Includes hardware, software, peripherals, service and maintenance

Source: *Datamation* magazine

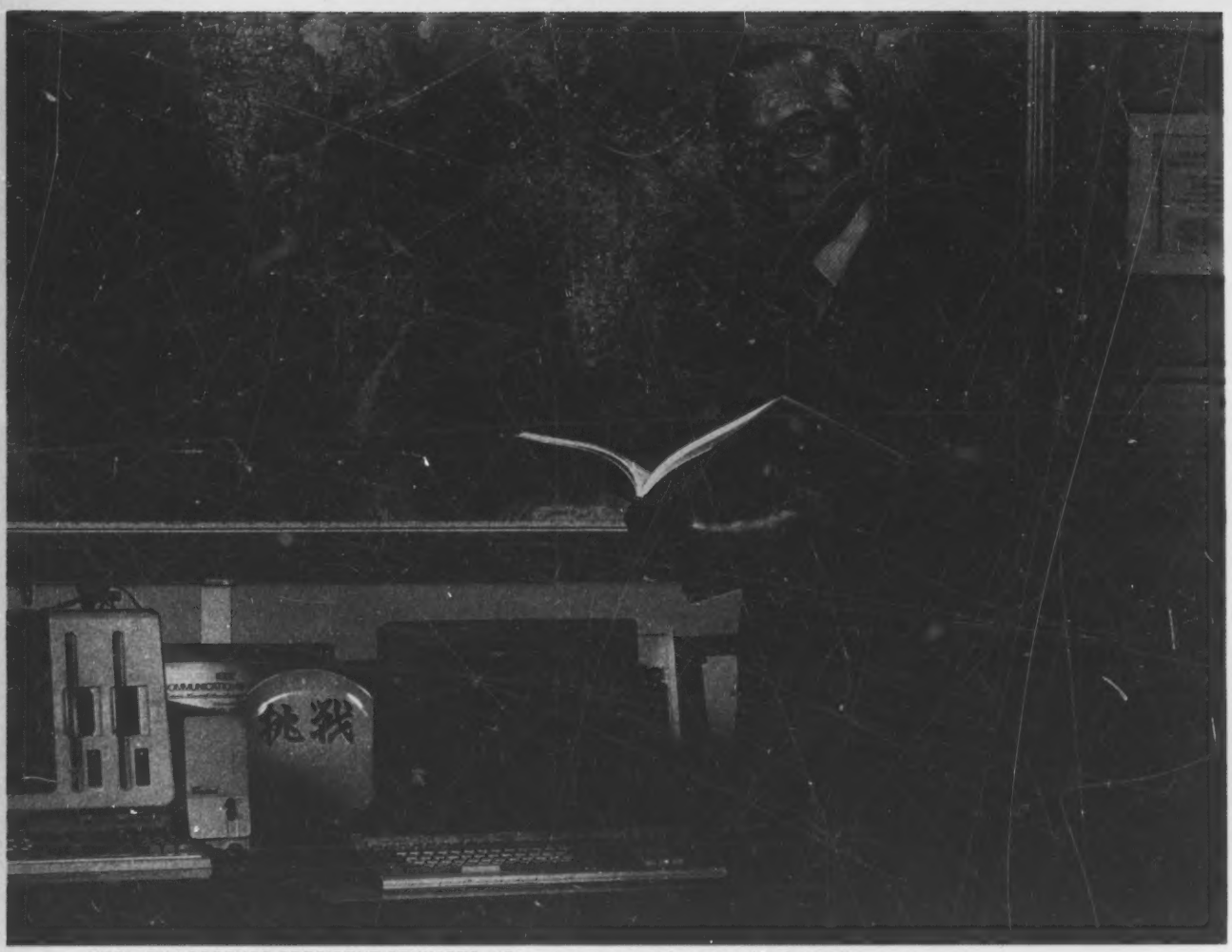
Telecommunications

1986 sales ($ billions)

1	**AT&T**	$16.2
2	**Alcatel N.V.**	8.0
3	**Siemens***	5.6
4	**Northern Telecom**	4.4
5	**NEC**	4.0
6	**Ericsson**	3.1
7	**Motorola**	2.8
8	**IBM**	2.7
9	**Philips**	2.0
10	**GEC**	1.9

* Includes Siemens' share of its joint venture with GTE

Source: Arthur D. Little Inc.



NEC's PHILOSOPHER PRESIDENT SEKIMOTO: "Our company must keep running forever"

weather the current yen crisis which has battered every export-oriented Japanese conglomerate. For over two years now, the yen's value has soared more than 70% upward against the dollar, making Japanese exports into the United States that much more expensive.

Instead of raising its U.S. prices accordingly, NEC is taking the bulk of the yen value's increase square on the chin. Consequently, the company suffered a huge 60% plunge in its total net income in 1985 and a subsequent 45% fall last year. In fact, the company barely eked a profit of $103 million on sales of $16.8 billion in fiscal 1986, ending last March. "NEC's earnings have been under extreme pressure recently," says George Haloulakos, analyst with Dain, Bosworth Inc., headquartered in Minneapolis. Adds C. Robin N. Norton, analyst with S.G. Warburg & Company Inc. of New York City: "NEC's technology is still very good but the profitability of that technology has fallen."

Rajiv Chaudhri of Goldman Sachs & Co. of New York City estimates that roughly 10% of NEC's total sales are made in North America. He questions whether NEC is profitable today in the United States. "In telecommunications," Chaudhri asserts, "NEC is definitely not profitable. They're getting killed here. In semiconductors, they may be breaking even .... On the whole, it's fair to say they're not making any money in the U.S. because the amount of money they are losing in telecommunications would not be made up by any profit that they might be making elsewhere." NEC executives deny that their U.S. operations are losing money. Still, Sho Nakanuma, associate senior vice president, admits: "¥140 to the dollar is very tough for us."

> It is NEC's flexibility that is helping the company weather the current yen crisis

It could get tougher. In Tokyo last month, rumors circulated that NEC was being investigated for allegedly selling contraband high-tech products to the Soviet bloc. The company and the U.S. government have denied the rumors. But the consequences could be catastrophic since Congress is already forcefully pressing Toshiba for exporting high-tech goods to Russia.

Grounding the soaring yen

Rumors regarding Russia notwithstanding, president Sekimoto has been busy implementing various strategies to offset the high-flying yen:

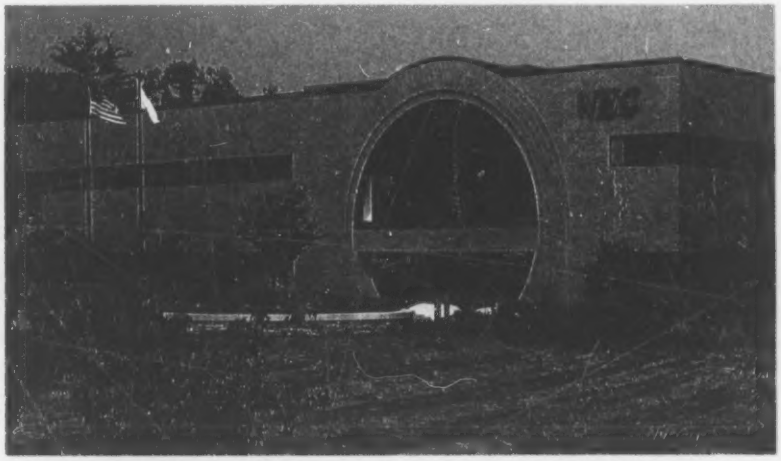
- *Cut production costs by applying draconian measures to increase productivity. In addition, buy more parts and raw materials offshore where the yen's higher purchasing power is an advantage.* So far, NEC has made great strides here. At one of its computer factories in Ibaraki, Japan, the company was able to double its pro-

ductivity within a year's time (See accompanying article.) And be sure that NEC is desperately looking to buy parts, particularly electronic components, from the newly industrialized countries (NICs). The problem, however, says NEC's top management, is that good quality parts cannot often be found outside of Japan.

- *Escape the clutches of the high-valued yen by doing more manufacturing outside of Japan.* Already one-third of NEC's foreign sales are produced overseas, according to Sekimoto. The company is planning to increase that ratio to one-half by 1990. In the United States, the company is quickly expanding chip production in Roseville, Calif.; computer and peripherals assembly in Boxborough, Mass., (see accompanying article); and PBX manufacturing in Dallas. In addition, Nakanuma says: "We are considering opening another semiconductor factory in the U.S." Last April, NEC commenced operations in a new chip plant in Livingston, Scotland. The company is especially interested in moving its manufacturing of commodity products to foreign countries. According to Toshiro Kunihiro, executive vice president, NEC will double its offshore production of key telephones and low-end private branch exchanges within the coming year.
- *Avoid competition from companies in Southeast Asia (where currencies have also fallen against the yen) by deemphasizing commodity products and concentrating on higher value-added ones that can command premium prices.* NEC already is much less dependent on commodity products than other Japanese conglomerates. Consumer products make up just 13% of NEC's total revenue whereas at Matsushita Electric Industrial Company Ltd. that percentage is 62%. NEC has begun to contract out its production of low-end consumer products to various Southeast Asian companies: some of NEC's microwave ovens, small-capacity refrigerators and small-screen televisions will reportedly now be made by South Korea's Daewoo Corp. and Goldstar Co. In addition, Sekimoto says that software will help NEC move further upmarket. "That is our goal today: products armored with software," says Sekimoto. He is also counting on software to help automate and

NEC here and abroad: A tale of two factories

For more than two years now, the value of the yen has been soaring against the dollar. Where ¥1000 was worth only $4.00 before, it is worth $6.85 today. This 71% shift in the yen's value has overjoyed the camera-toting Japanese tourist but not his employer. Exporting manufacturers in Japan now find that, at the same yen prices, their products in the United States are 71% more expensive in dollar terms. This new currency reality has forced Japanese executives to revamp their manufacturing strategies.



NEC's BOXBOROUGH FACTORY in Massachusetts will begin assembling disk drives this fall and printers early next year. Business is booming

The best of times

NEC's computer plant in Boxborough, Mass., is now bustling, due in part to the yen's appreciation. The total number of workers involved in manufacturing at NEC Information Systems Inc. (NEC IS), which runs the Boxborough facility, has increased from around 200 employees to more than 300 employees over the past year, according to Herbert A. Spivak, NEC IS vice president for manufacturing. Spivak contends that, at an exchange rate of ¥140 = $1, manufacturing labor costs between the United States and Japan are roughly equal, all things considered, including employee benefits.

The Boxborough plant — supplier of computer hardware to Honeywell, NCR, Prime, Tandem and Wang — commenced manufacturing nearly two years ago with the monthly assembly of 10,000 printer form feeders. Although all of the parts for the feeders were originally imported from Japan, NEC IS currently buys the plastic ones locally because they are 15% cheaper in the United States due to the yen appreciation, according to Spivak. He is looking locally also to procure the metal parts for the feeders because, at the current yen/dollar exchange rate, those parts cost the same in the states as they do in Japan, he says.

More recently, the plant began assembling and testing NEC's personal computers. According to Spivak, NEC IS made the decision to assemble PCs in Boxborough in order to avoid the 100% tariffs that the Reagan Administration imposed on imported Japanese PCs last April. Furthermore, Spivak adds, "with the yen the way it is, there is no advantage to importing PCs from Japan."

The Boxborough plant currently imports the major PC parts such as the disk drives, power supplies and motherboards from Japan. Only the Intel Corp. microprocessor and some chips from Chips and Technologies Inc. of Milpitas, Calif., are procured locally, according to Spivak. However, he says NEC IS is currently taking local price quotes for the PC metal housing and chassis parts. The Boxborough plant's next

make NEC's manufacturing operations more versatile. "Before," says Sekimoto, "mass manufacturing was considered to be the source of profit. Today, we have to change our manufacturing mindset from mass production to the production of a greater variety of products in smaller lots."

- *Protect NEC from any further increase in the yen's value by locking in contracts with banks to exchange the dollar at a guaranteed rate.*

Thanks to Sekimoto's quick actions, particularly in increasing offshore manufacturing, NEC is well on its way to recovery. The company is predicting that its total net income will rebound to $171 million this year, a 66% increase over last years' results. Furthermore, NEC estimates that sales this year will increase 10% to $18.5 billion.

But, even though NEC has been experiencing extreme profit pressures because of the strong yen, the company has not been R&D stingy. NEC has maintained a research and development spending level of around 12% of total sales. Two years ago, the company spent 14%. In contrast, IBM spent 8% last year while AT&T spent 7%. "NEC operates on pretty thin profit margins. They plow a lot into R&D and capital investments," says Norton of S.G. Warburg. NEC's shareholders have seemed content to let the company operate on meager margins. It does not hurt that the giant Sumitomo Bank of Tokyo holds 5% of NEC's stock.

NEC has maintained an R&D spending level of around 12% of total sales

According to Sekimoto, NEC will maintain an R&D spending level of at least 10% of total revenue, come rain or shine. "U.S. companies try to save R&D money immediately when their profitability decreases. But not NEC. There is only one way NEC can survive: by spending money on R&D," says Sekimoto. Adds Yoshiteru Ishii, senior executive vice president: "NEC does not skimp." Indeed, the company uses an aggressive three-year depreciation plan which allows for up to 50% depreciation in the first

step is to buy the PC power supplies from local vendors.

"Our long-term corporate objective is to, as much as possible, design products in the U.S. and build them here for the U.S. market," says Spivak. He lists several reasons why NEC IS wants to increase its U.S. manufacturing: to be closer to the local market, to avoid any tariffs, for political goodwill, and, he adds, "because of the strong yen, it's become economically sensible as well." Indeed, NEC IS is planning to begin assembling disk drives this fall and printers early next year.

The worst of times

While the strong yen has been a blessing for NEC's Boxborough facility, it has been a curse to the company's plant in Ibaraki, Japan, where NEC manufactures mainframe computers and Winchester disk drives. Fully 40% of the Ibaraki plant's output is sold outside of Japan and is consequently subject to considerable price inflation. Not surprisingly, the factory was ordered to slash production costs immediately. Or else.

The Ibaraki plant was up to the task. According to Junzo Yamamoto, NEC Ibaraki Ltd. president, the manufacturing facility was able to double its productivity within one year. Yamamoto credits employee involvement with the achievement. Through an employee suggestion box, 24,000 propductivity enhancing recommendations were received last year from 600 workers directly involved in the manufacturing process. Of the 24,000 suggestions, more than 1,000 were implemented which helped achieve the 100% increase in productivity, according to Yamamoto.

NEC's IBARAKI FACTORY has been ordered to cut costs drastically. According to the facility's manager, productivity should double within the next two years

Inside the Ibaraki plant is a bulletin board that tracks which employees have submitted the highest number of suggestions. For the first three months this year, the leading employee had already proposed 410 suggestions. Yamamoto's valiant goal is to double again his factory's productivity within the next two years. He is striving for twice as many employee suggestions this year.

Yamamoto adds that besides employee suggestions, automation has also helped to increase his factory's productivity. According to him, the Ibaraki facility is now 70% automated, up from around 50% a few years ago. This is in sharp contrast to NEC's Boxborough plant where virtually all of the labor is done by hand.

In addition to cost slashing, Yamamoto has also been busy trying to procure cheaper parts and raw materials from Southeast Asia, where the yen's strong purchasing power is an advantage. However, he says, "good disk-drive components are difficult to find outside of Japan." Foreign suppliers might do well to visit Ibaraki. According to Yamamoto, only one foreign salesman, from U.S. capacitor manufacturer AVX Corp., has called on him during his four years at Ibaraki. The AVX salesman got the order. □

year, according to Chaudhri of Goldman Sachs. Such a plan, says Chaudhri, allows NEC to stay at the leading edge of manufacturing technology by replacing old equipment quickly.

In his discourse of NEC's management precepts of foresight, execution, perseverance and flexibility, Sekimoto forgot to mention one more item: courage. With Japanese-style chutzpah, NEC has made many a gutsy decision. Instead of developing IBM-compatible mainframe computers as did compatriots Fujitsu Ltd. and Hitachi Ltd., NEC instead chose IBM independence. And NEC is the first major Japanese company to market a proprietary microprocessor architecture. □

Chip challenges, a Roseville by any other name

NEC's strategy to push its homemade microprocessor is bold to say the least. The industry has for years been ruled by U.S. architectures from companies such as Intel Corp., Motorola Inc., National Semiconductor Corp. and Zilog Inc. The Japanese companies historically have been content to second source the U.S. designs.

And the Japanese companies have done well by such arrangements. NEC, a second source of the Intel architecture, was No. 2 worldwide in the metal-oxide semiconductor (MOS) microprocessor and corresponding peripheral chip market with sales of $525 million last year, according to Integrated Circuit Engineering Corp. (ICE), a market research firm in Scottsdale, Ariz. And Hitachi, a Motorola second source, was No. 4 with sales of $160 million, according to ICE. But, clearly, NEC has tired of its dependence on Intel. Sho Nakanuma, a NEC vice president and former head of the company's U.S. chip operations, says that he hopes to establish one more standard in the marketplace, that of NEC's V-series architecture.

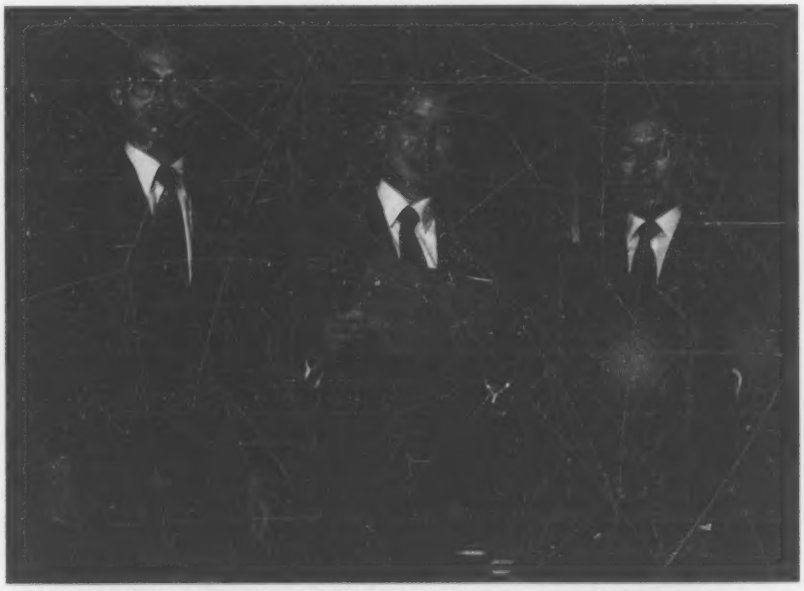
But Nakanuma's plan has hit a snag. Intel is suing NEC, claiming that NEC's V20 and V30 microprocessors are not originals but disguised copies of Intel's products. So far the U.S. courts have ruled that Intel's microcode, the software instruction set embedded in the microprocessor hardware, is copyrightable. But the courts have yet to decide whether or not NEC infringed on that copyright.

The case has been dragging on for more than a year now, which apparently suits NEC just fine. Nakanuma says that the life span of the V20 and V30 is getting shorter day by day. Meanwhile, NEC announced last April its newest microprocessor, the 32-bit V70 which supports the Unix operating system. Nakanuma asserts that there will be no copyright problems with the V70. "The V70 is 'cleanroom' microcode. We developed it without any knowledge of the Intel microcode," he says.

Regardless, legal problems may be the least of NEC's concerns. Convincing customers to switch from Intel, Motorola or National will be difficult, admits Nakanuma. Accordingly, NEC's plan is to first pursue niches in the marketplace. With sample shipments that commenced last July, NEC is targeting applications in computer-aided design/manufacturing, private branch exchanges, robotics and other industrial equipment. Although the outcome of NEC's push to create another standard in the industry is highly uncertain, Nakanuma is determined: "The V70 is an investment in the future." NEC itself will be using the V70 in a new 32-bit PC.

V70 shipments will take awhile to ramp up, but business at the company's Roseville, Calif., plant is booming. In a curious turn of events, last year's U.S.-Japan semiconductor trade pact is actually aiding NEC's U.S. chip efforts. Because the pact implements price floors on Japanese imported chips and because other Japanese companies do not have the U.S. manufacturing capability that NEC does, the trade agreement is favoring NEC over its Japanese peers. Furthermore, the pact covers certain DRAMs, a type of memory chip that most U.S. manufacturers gave up making years ago.

Consequently, NEC's Roseville plant is racing along at top speed. With full wafer-fabrication capability, the facility is churning out 70% more chips this year than last year, according to Nakanuma. Currently, 3 million to 3.5 million 256-kilobit DRAMs are being produced there monthly. NEC expects that figure to rise to 4 million soon. Not surprisingly, NEC plans to expand its $100 million Roseville plant. By the early 1990s, the company will have invested an additional $600 million in Roseville and the facility will then be employing 3,000 people, up from 650



NEC's KUNIHIRO (left), **ISHII** and **NAKANUMA** (right): Communications, computer and chip guardians of the company's Triple Crown in electronics

DISTRIBUTION

Tape drive? Computer? Coming right up, sir

Alongside chips, distributors now offer computer products galore. One day they might even make money at it

By John Kerr

When Digital Equipment Corp. handed all its smaller end user and reseller accounts to industrial distributors this spring, it may as well have hoisted a banner declaring: "Distribution gets our vote!"

It is a vote cast more often by computer product vendors these days as their distributors grasp the nuances of selling everything from tape drives to completely configured minicomputer systems.

Increasingly too, distributors are marketing vendors' wares not only to original equipment manufacturers but to value-added resellers and even to end users.

But the business of selling computer systems and subsystems cannot yet be termed an unqualified success for distributors. "There have never been any problems with growing; the problem's been making money," says Robert Throop, chief executive of San Jose-based Anthem Electronics Inc., one of the few distributors to consistently make handsome profits.

It is true: profitability in systems sales hardly afflicts the middlemen en masse: "There are many who consider systems break-even at best," says Stephen Kaufman, president of Arrow Electronics Inc. of Melville, N.Y., the third-ranking U.S. industrial which Kaufman admits makes little or no money on computer products.

However, distributors may be making progress in coping with customers. Says William Roach, worldwide director of distributor marketing and sales at Santa Clara, California-based Intel Corp., which uses distributors to sell many of its single-board computers and microprocessor development systems: "In the last three years, industrial distribution has evolved into an effective channel. Probably the biggest single factor is that they are becoming much more competent technically."

Observers maintain that computer products gave the distribution business its only growth during the semiconductor downturn

Adds Peter Snell, director of reseller marketing for San Jose terminals maker Wyse Technology: "It's been our experience that [distributors] have been very strong partners for Wyse."

Customers notice the difference. "They've become quite a lot more responsive in the past two years," says Lynde Wylie, administrative assistant at Aurotech Inc., a small Denver VAR that buys monitors and printers from distributors for use in food management systems. Another praises Cypress, California-based Ducommun Data Systems (DDS), a division of Ducommun Inc., for burning in the AT&T 3B minicomputers that it buys, and for loading the Unix operating software, a job that takes hours.

Computer products, in turn, get the thumbs-up from hungry distributors. Several observers maintain that disk drives, printers, desktop computers and the like gave the distribution business its only growth during the dog days of the semiconductor downturn — indeed, that 70% of the industry's growth in volume since 1980 has come from systems.

Others cite vast market potential: in its 1987 annual report, Cleveland-based distributor Pioneer-Standard Electronics Inc. claims that although about 30% of component sales move through distributors, under 2% of management information systems sales now use that channel. "I would describe computer systems' potential as explosive — I don't think that's overstated," adds Ralph Ozorkiewicz, president of Wyle Laboratories' Electronics Marketing Group in Irvine, Calif.

Distributors' computer products sales have clearly been climbing steadily. Wyle's Ozorkiewicz sees his systems sales expanding 30% a year at least over the next three years — three times the average growth the industry can expect. At big league companies like Anthem, Arrow, Pioneer and Wyle, a third of their revenue

now comes from computer products. At the electronics group of Ducommun — one of the largest distributors of computer equipment — the figure is 40%.

Financial analysts who follow the distribution business agree that computer systems will be distributors' fastest growth prospect by far. At San Francisco brokerage Montgomery Securities, analyst Andrew Neff sees systems generating $2.45 billion of electronics distribution's total $7.9 billion in sales in 1988, up from $1.8 billion of last year's aggregate of $6.3 billion.

Vendors are looking for similar leaps: Intel's Roach expects his distributor sales to double next year from this year's $100 million-plus. DEC's plan calls for more than quadrupling annual revenue through distributors to over $1 billion by 1990, with half of that expected from industry leader Hamilton/Avnet alone.

Acceleration of distributors' computer product sales is no accident. The personal computer phenomenon gave it a jolt as small peripherals fast became commodities and as more and more vendors viewed distribution as the natural extension of their salesforces — the channel that would reach the second- and third-tier customers.

Another factor: those smaller customers — many of them VARs — constitute a rapidly expanding new market that is well worth cultivating: some will turn out to be the Intels and DECs of tomorrow.

Additionally, the products, such as disk drives and terminals, have become more standardized while distributors have become more familiar with them and more technically able to handle them. The trend continues: integration of controller boards onto disk drives, for example, makes the sell simpler. Meanwhile, customers are showing a growing tendency to buy systems and subsystems, rather than making their own from components.

WILLIAM ROACH, worldwide director of distributor marketing and sales at Intel: "In the last three years, industrial distribution has evolved into an effective channel"

Channeling

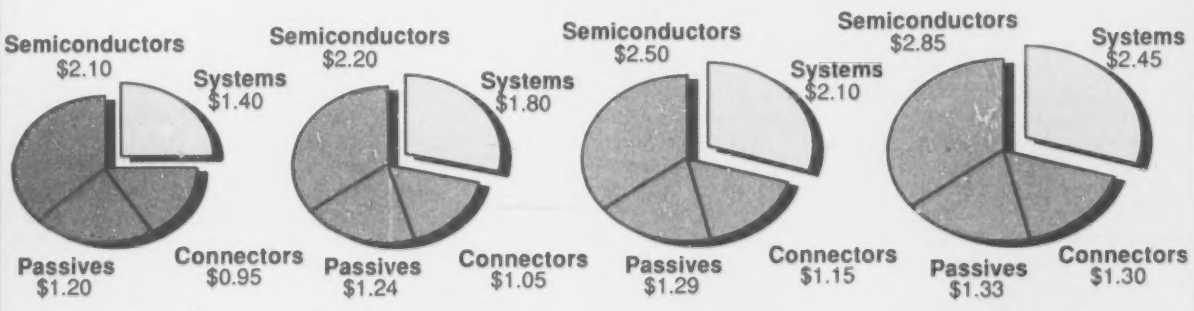
Distribution's computer products sales are an outgrowth of franchises for microprocessors; many potential users began buying board- and box-level processors rather than buying and assembling the individual chips; others chose boards or boxes as platforms to experiment with microprocessors before committing to purchase.

The sector easily predates the PC; at about the time the earliest Apples were appearing, about 4% of distribution's sales already came from systems. Intel was using the channel from the early 1970s, and gave it a sizable boost with its Technical Distributor (TD) program five years ago.

Indeed, Intel makes so bold as to suggest that it oiled the wheels for others' distributor programs: "Most of our distributors agree that if we hadn't done TD, they probably

The rise of systems sales in industrial distribution

U.S. distribution industry sales ($ billions)



Total 1985 sales $5.65 billion

Total 1986 sales $6.29 billion

Total 1987 sales $7.04 billion

Total 1988 sales $7.93 billion

Source: Montgomery Securities

Tim Davis

wouldn't have been as attractive to DEC," boasts Roach.

The TD program provides special incentives for distributors — up to 30% higher margins if they comply with all conditions, such as technical training by Intel, aggressive sales quotas and most controversial of all — distributor salespeople dedicated to Intel product.

Some say the program is too tough by far. Argues one Intel distributor who asked not to be named: "Intel's systems are extremely unprofitable for a distributor. If Intel wants a dedicated resource, why don't they do it themselves? They know it doesn't make money, so they're trying to force it on distribution. The whole premise of distribution has always been sharing of the resources."

Wyle's Ozorkiewicz, another Intel middleman, says that the chip maker changed its ways early this year in response to persuasion from several distributors hurt by having to field dedicated Intel salespeople in limited markets like Utah. Intel product, he says, is now "one of the best opportunities in distribution;" on Intel's single-board computer, Ozorkiewicz claims that a fully qualified TD distributor can make margins averaging 6% to 8% higher than on comparable competitive products.

DEC's program — a consolidation of five earlier reseller arrangements — is far reaching. Announced in mid-March, the program sees the Maynard, Mass., computer giant giving distributors all of its end user and reseller accounts of $500,000 and under in annual value. Hamilton/Avnet, which gets to sell DEC's entire product line, except for its mainframes, is expected to provide about half of DEC's new distributor sales.

Major vendors are taking pains to avoid clashes between their direct sales teams and their distributors. Explains Roach of Intel: "We try to take the business through the most cost-effective channel." He says that if a distributor lands a big order — and some seven-figure deals are now in the works — Intel will not steal the business for its direct salespeople. In practice, the vendor's strategy usually involves an equitable split of the profits between its own salespeople and those of the distributor.

Distributors stumbled badly in the early days, trying to pitch computer products as if they were connectors and wondering what buyers meant when they asked technical questions. Distributors also got into trouble selling to end users, often believing that the salesman who sold to OEMs could hit up other markets too.

PETER SNELL, director of reseller marketing for Wyse Technology: "It's been our experience that [distributors] have been very strong partners"

Distributors also botched up trying to sell to computer retailers: "Avnet tried to act as a master distributor selling the DEC Rainbow PC, and it was a disaster," says Frederick Wolf, an analyst with Mabon Nugent & Co. in New York City. And Pioneer took a bath in the same area before putting its Srepco consumer products division on the block earlier this year. One reason why distributors found retail hard going: the quality of credit from retailers was less than what they were accustomed to.

Distributors stumbled badly in the early days, trying to pitch computer products as if they were connectors

Much has changed. "Distributors have spent quite a bit of time and money to educate themselves about the systems market," comments one supplier. Commitments to systems sales have been made in the boardrooms of top distributors, and many have established separate businesses with separate sales staffs to sell computer products. Players like Hamilton/Avnet, where a third of the 700-strong salesforce does nothing but sell computer equipment, have built teams of engineers to back their salespeople.

Ducommun has one of the most clearly defined segregations. Its Kierulff Electronics unit sells about a third of its product to OEMs, while sister divisions DDS and MTI Systems Corp. handle VAR and end-user sales respectively. AT&T and DEC both utilize two or more Ducommun units.

Distribution "diskoveries"

Today it is conventional for systems vendors to utilize distribution, often as a means to get in early in customers' design cycles. "I think it's very important early on to develop a distribution channel," says Finis Conner, chairman of Conner Peripherals Inc., a San Jose start-up founded only last year to make 3.5-inch Winchester disk drives. Conner expects up to 15% of his sales to come from distribution next year, and perhaps 25% by 1989.

Another drive maker, Seagate Technology of Scotts Valley, Calif., pushes about 15% of its product through distributors. At tape-drive company Archive Corp. of Costa Mesa, Calif., the ratio is the same, although it is expected to climb. And at terminals titan Wyse, one-fifth of the top line can thank distribution.

Evidently emboldened by successes with commodity computer products, distributors are now starting to sell to VARs and even to end users. Even Anthem, the most profitable of all

Tim Davis

ROBERT THROOP, chief executive of Anthem Electronics: "There have never been any problems with growing; the problem's been making money"

distributors and a stalwart of OEM subsystem sales, is putting together a VAR program.

The profit potential is better — from 5% to 8% better than OEM computer systems sales since much more customer handholding is required, according to Wyle's Ozorkiewicz. And the growth opportunities are substantial. Notes Toby Mack, executive vice president of the National Electronic Distributors Association (NEDA): "The huge base of VARs that has emerged has become a natural constituency for distributors."

Wyle now has a VAR marketing channel which yields over 20% of its computer-systems trade, with higher percentages to come. For Arrow, the figure is over 35%. Vendors expect to benefit from distributors' vaulting VAR business: Archive has designed a tape drive specifically for that channel, while Intel already has 25% of its distribution sales coming from VARs.

Other distributors that feel they can add some value — and profit — themselves. In May, Arrow signed with IBM to sell the new Personal System/2 desktop computers nationwide to end users. Arrow will configure the package with software for vertical markets.

Others are probing into end-user sales: under DEC's new program, Hamilton/Avnet is an outlet for minicomputers; indeed, the distributor claims that end-user business will make up as much as a third of its DEC sales this fiscal year.

At this point, distributors are wandering into dangerous territory. Some observers caution that end-user business can involve leasing arrangements that put the financial burden on distributors; others believe that clashes between the channels are inevitable as the distinctions blur: "It's hard to sell to VARs and also be one," cautions NEDA's Toby Mack.

Terminals vendor Wyse proposes a solution: peace through partition, where distributors add hardware value, and VARs add software to tailor the equipment to vertical applications.

With such faith from suppliers, and such demand, it's a wonder that the systems business is not universally profitable for distributors. While participants like Anthem and Wyle show what can be done in the way of profits, many others remain strapped by computer products' inherently lower gross margins. "Margins run in the high teens rather than the low twenties," reports Arrow's Kaufman.

Pricing issues

Regrettably, systems' high average selling prices, few part numbers and fast inventory turns — Anthem claims up to 10 turns annually while Arrow consistently shifts the shelves six or seven times a year — are no match for margins that sit four or five percent lower than for semiconductors.

Alongside Arrow, Ducommun's DDS and Kierulff divisions remain in the red, and do not expect to climb out until later this year. (Interestingly, Ducommun's other unit, end-user marketeer MTI, is well into the black.) Lex Service Plc's David Jamison Carlyle Corp. unit, now renamed Lex Computer Systems, is working hard to curb losses; in 1986, a major restructuring that involved a 20% salesforce cut helped bring the negative earnings back down to $2.5 million from $4.8 million in 1985. Managed properly, the new DEC program may be of considerable benefit to Lex.

DDS and Kierulff are working hard to clean up their line cards, shutting down lackluster lines for more promising ones like Seagate disk drives. Arrow is doing likewise. The moves are intended to do what distributors should have been doing all along: focusing large doses of sales effort on fewer customers.

Ducommun is also expanding its MTI unrit from 10 to 18 locations in a bid for more end-user action, and

RALPH OZORKIEWICZ, president of Wyle Laboratories' Electronics Marketing Group, sees his systems sales expanding 30% a year at least over the next three years

hopefully, to double sales over the next couple of years from today's $50 million level.

Others are stepping up the pace to make sure that systems sales sparkle. Wyle, which also stocks DEC's MicroVAX II minicomputer, Wyse's PCs and terminals and NCR Corp.'s Tower computer, is launching a recruitment drive; over the next two years, it expects to hire more than 100 new salespeople — two-thirds of them right out of college. At present, 20% of Wyle's 200-strong salesforce handle computer products only, and another 20% sell both components and systems. The hiring binge should bolster the ranks of systems salespeople by 25% by 1989.

Likewise at Pioneer-Standard, where analysts say sales of Western Digital Corp. disk controllers, Maxtor Corp. optical disk drives, Texas Instruments Inc. printers and much else will do a lot to propel sales about 5% faster than the industry average. Says chairman Preston Heller Jr.: "[Our salesforce head count] will climb in advance of sales, to drive sales."

With the pundits predicting that computer products will fuel much of the 12% to 13% annual growth in distribution sales, it is tempting to think that distribution's troubles are over. Too bad that profits do not automatically follow sales. Concludes Montgomery Securities analyst Neff: "Looking at the business prospects for this year, the alternatives are fairly clear: this industry either needs more sales or fewer competitors." □

PERIPHERALS

The Year of the Rabbit and the 3.5-inch Winchester

This year, for the first time, low-end 3.5-inch disk drive shipments are expected to exceed 5.25-inch models

By John Kerr

In China, 1987 goes down in the history books as "The Year of the Rabbit." In the United States, disk-drive makers may remember it better as "The Year of the 3.5-inch Winchester."

The label is apt: a myriad of indicators point to this as the year when the tiny fixed-disk drives come into their own at last. "Up, up, up!" is how William Schroeder, president of Conner Peripherals Inc., describes demand for the 3.5-inch units that his San Jose-based company was founded last year expressly to build.

It remains to be seen, however, whether the drive makers can convert that demand into production; at least one vendor of thin-film media — the disk platters themselves — believes high-performance media will be in short supply for awhile.

Production constraints aside, the outlook is hard to beat — despite some resistance among computer users to convert data stored on 5.25-inch drives to the new format. Indeed, there is still a question whether or not "the 3.5 will be the only low-end drive," says Allen Herder, marketing manager for personal mass storage products at Hewlett-Packard Co. "Clone makers are typically driven by price. I don't think they care [which format they use]."

Nevertheless, Los Altos, California-based market researcher Disk/Trend Inc. predicts that in 1987, worldwide original-equipment manufacturer shipments of low-end 3.5-inch units — below 30 megabytes of capacity — will for the first time outpace those of the equivalent 5.25-inch drives, a significant milestone for the mini mass-storage machines.

Another data digger, InfoCorp of Cupertino, Calif., believes that by 1991, the mini-Winchesters will account for more than 70% of the rigid drives used on computer systems priced between $500 and $6,000.

The outlook is hard to beat, despite some resistance among computer users to convert data stored on 5.25-inch drives to a newer format

Observers also point to burgeoning after-market demand. According to San Jose research firm Dataquest, worldwide shipments of 3.5-inch rigid subsystems for the after-market will grow nearly 25% annually, from 833,000 units last year and roughly 1,250,000 this year, to 2,023,500 in 1990.

Product blizzard

Not surprisingly, there has been a blizzard of recent product announcements heralding the high-performance miniature Winchesters to come — 3.5s with Porsche-like access times as sleek as 25 milliseconds (ms) and enough memory to make an elephant blush. Most are geared to the demands of the latest personal computers driven by Intel Corp.'s 80386 microprocessor.

Consider too that blue-chip OEMs of PCs have started to design 3.5-inch bezels — spaces for the small drives — instead of popping the 3.5s into 5.25-inch holes, and it is apparent that the next logical step in mass-storage downsizing — from 5.25- to 3.5-inch form factors — is well under way.

Says William Hake, vice president for 3.5-inch products at Longmont, Colorado-based MiniScribe Corp.: "We've been waiting for a couple of years for this point. You could say this is the year the 3.5-inch form factor has finally arrived."

Meanwhile, British firm Rodime Plc, a pioneering 3.5-inch vendor, is angling for its share of the market. Having been Apple Computer Inc.'s longtime sole source for 3.5-inch 30MB Winchesters, Rodime this spring watched Apple qualify another vendor — reportedly archrival MiniScribe. Last year Apple provided 40% of Rodime's sales. But outwardly, the company is sanguine. "We're basically shipping as much as we ever were," says Gary Janz, Rodime's director of marketing. "Apple has always been pleased with the quality of our products."

Interest in 3.5-inch rigids is quickening pulses on Wall Street. Declares Andrew Neff, an investment analyst with San Francisco brokerage Montgomery Securities: "We believe that 3.5-inch Winchester disk drives will become the next major area of investor attention [and opportunity] in the data-storage industry."

In a recent report, Neff estimates that revenue from shipments of miniature Winchesters could more than double in 1987 to top $1.4 billion, and grow at a compound annual rate

of over 60% through 1989.

Apple was one of the first OEMs to accept the format as standard in its Macintosh PCs. Analysts now estimate that 80% of the Macintosh SEs are shipped with 20MB 3.5-inch hard drives aboard. With Macintosh family sales on a roll, the company expects to complete its plan to migrate all of its 40MB hard drives from the 5.25-inch to the 3.5-inch size by February 1988, and to push onward to 80 MB six months later.

Compaq Computer Corp. also has recently backed the breed. Its Portable II and Deskpro 286 machines feature 20MB minidrives, and its Portable III uses 20MB and 40MB models with data-access times less than 30 ms. All of these drives are made by Conner Peripherals, in which Compaq has a 50% equity stake.

No prizes for guessing the source of the most significant endorsement of all — the one that is stimulating enquiries and bookings at several 3.5-inch vendors. When IBM unveiled its Personal System/2 PCs in April, it bestowed the Big Blue benediction upon the form factor by including 20MB versions in the System/2 Models 30 and 50.

And, although the engineering workstation market is still geared toward 5.25-inch, there is rich promise for the new breed of high-performance 3.5s. Mountain View workstation leader Sun Microsystems Inc. expects to begin designing in the 3.5-inch drives in "less than a year and more than six months" according to Jon Garman, director of engineering of the workstation division.

Sun won't employ the slow 20MB models featured in IBM's new PCs. "We can't build standalone workstations with less than 100MB on disk," explains Garman, adding that such units typically need drives with at least five times their substantial onboard memory.

Smaller workstation dimensions are also critical. "Believe it or not, everybody worries about footprint," declares Garman. Keeping the center of a large workstation screen at the users' eye level is a vital consideration, and one that will be met more easily with the little drives.

But the technical feature that attracts most systems builders is the low power requirement of the 3.5-inch drives, which often eliminates need for cooling fans and so further reduces space. Half-height 5.25-inch drives can devour up to 25 watts, while the minirigids sip 10 watts and less. Conner already claims just 6 watts for its 40MB model — critical for use in portables and valuable to customers like Apple that already want less than 5 watts.

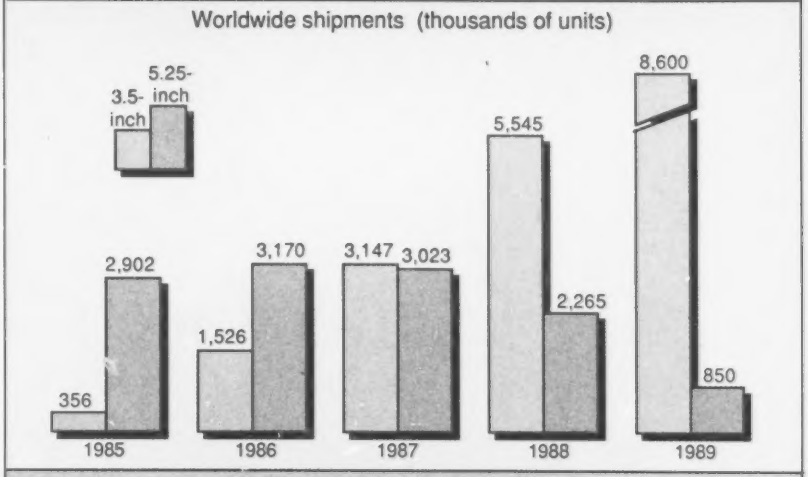
Access times — the time it takes to tap into data on a disk — are also tightening up: where the lower end 3.5-inch units are happy to get at the data in 80 ms, breathless newcomers are there in less than 30 ms. Compaq is using rapid data access as a selling feature to differentiate its PCs. "When you get into networking, faster access times become important," says MiniScribe's Hake, whose 8425F 20MB 3.5-inch model accesses in 40 ms.

The 3.5-inch Winchesters are also said to be more reliable than their larger cousins. John Hagerman, product marketing director at San Jose-based Priam Corp., which plans to unveil a high-end unit early next year, points to mean times between failures climbing above 30,000 hours and nonoperating shock resistance as high as 75 g compared with the 20 g common to 5.25-inch models. (A "g" is the unit force to which a body is subjected during acceleration.) Partly ,this is due to the very large scale integration chip sets used to pack more drive into less space; partly, it's an attempt to meet the harsher environment today's desktop PCs face.

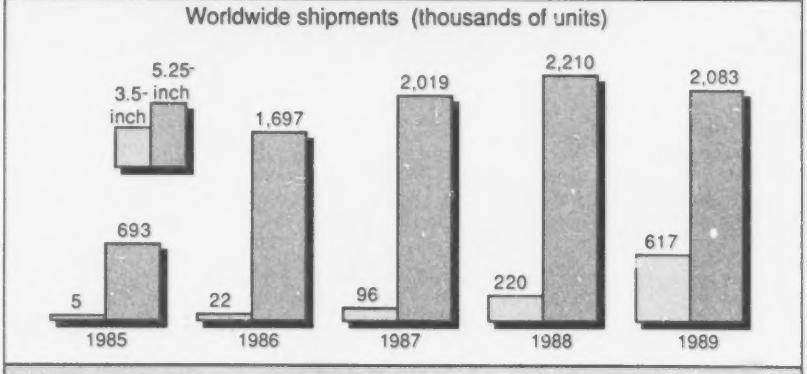
But why are 3.5-inch drives only emerging now? The form factor is already several years old. The answer is fourfold:

- First: Mainstream 5.25-inch rigids

This year, 3.5-inch rigid-disk drives will outsell sub-30MB 5.25-inch units...



...and start to make waves in 30MB-100MB sectors



Source: Disk/Trend Inc.

are migrating from 50MB to 100MB capacities, pulling 3.5-inch into their 20MB to 40MB wake, according to InfoCorp researchers.

- Second: It takes blue-chip backing to provide some market momentum — and there's none bluer than Big Blue. "What made the industry go to 5.25-inch was IBM," recalls Montgomery Securities' Neff.
- Third: Then there are technical factors: the thin-film media needed to pack the same volume of data onto smaller disks were not available in reliable quantities, and new downsizing manufacturing techniques — use of surface-mounted components and custom chips — took time to evolve. Also, the Small Computer Systems Interface (SCSI) is emerging as a dominant standard and it is one that vendors of 3.5-inch drives have been quick to back.
- Fourth: Time was the final ingredient in forging the right market attitude: the complex blend of vendor pressure and customer demand that defines the psychology of the market and declares that the next downsizing stage has arrived.

Pricing issues

That same psychology is driving prices of 3.5-inch Winchesters downward. At its most elementary, it states that the smaller the drive, the lower the unit price. MiniScribe's Hake says 5.25-inch half-heights still have a cost advantage; he cites a $10 gap between a 68 ms, 20MB 3.5-inch model and its larger half-height cousin costing perhaps $240 in OEM volumes. "In the second half of this year you'll see parity," says Hake.

New 3.5-inch Winchesters are emerging with sub-30 ms access times and huge storage capacities

Brand	Model	Capacity (megabytes)	Access time (milliseconds)
Maxtor	LXT-170	170	20
Conner	CP3100	100	25
Conner	CP340	40	29
Rodime	3085S	70	28
Rodime	3070S	58	28
Rodime	3057S	45	28
Seagate	ST157N	45	30

Source: InfoCorp

Participants expect pricing of low- and midrange units to erode at a now-familiar 10%-plus annually, and they are preparing for it. "In the first full year of production you've got to be competitive with 5.25. The second year, you've got to have some very, very aggressive pricing targets and know how to get cost out of your product," says Skip Kilsdonk, marketing director for Maxtor Corp., a San Jose maker of very high performance drives.

Maxtor is one of the latest to enter the 3.5-inch game; it joins a pack of over two dozen players, but will compete against only very few in the high-end with the 170MB, 20-ms LXT-170 unit it unveiled this spring. "We plan to offer everything in 3.5-inch that we offer in 5.25-inch," says Kilsdonk. Although the new drive is just beginning customer evaluation, Kilsdonk estimates that he will ship over 100,000 of them in 1988. By 1990, he predicts, 40% of his sales will be from 3.5-inch products.

Seagate Technology of Scotts Valley, Calif., has also shown its hand with its 20MB model ST125 and 30MB ST138, both with 30-ms access times. Quantum Corp. of Milpitas, Calif., is readying its own contender; Chatsworth, California-based Micropolis Corp. is thinking about it; and Conner is doing it already.

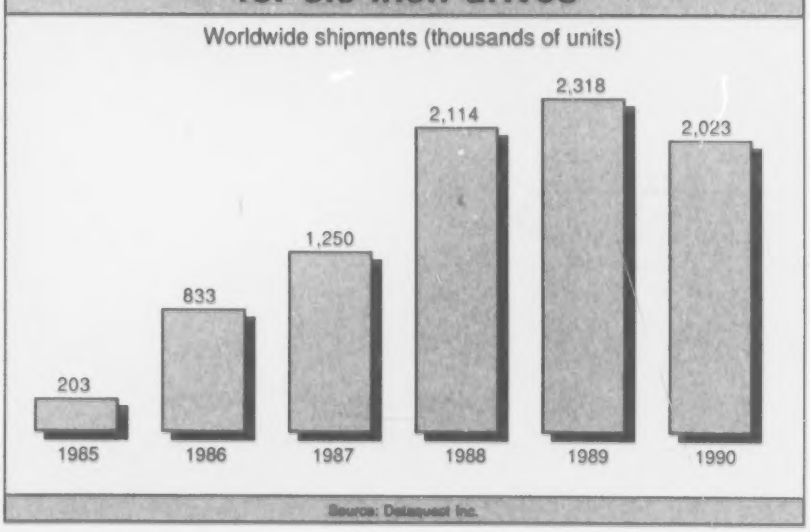
Boasts founder and disk-drive guru Finis Conner: "We did more sales in our first quarter than Seagate did in their first year of equivalent sales." Those sales: $10 million in the first quarter — 75% from stockholder Compaq — and unit sales that may make Disk/Trend's projections look positively cautious.

Conner also claims to be operating profitably, with gross margins "in the 30 percents." He expects present production of 1,000 40MB and 100MB models a day to double by this fall. The 40MB drive lists for under $600 in volume; Conner is keeping costs down with undisclosed methods of testing during manufacture.

But 3.5-inch drives will not go anywhere without disks and recording heads. Makers of thin-film media had early difficulty maintaining quality in high volume, and may still have problems meeting demand for the new high-performance mini-drives. "There just isn't enough good quality high-capacity media out there in the industry right now, and I don't think there's going to be enough for a year and a half or two years," says Stephen Johnson, president of Milpitas-based media maker Komag Inc.

That is apparently open to debate. Fellow media manufacturer Kenneth Lee, vice president for product development at neighboring Domain Technology Inc., cites a study showing that the combined top five domestic media suppliers can exceed worldwide demand by 20% to 30% by 1990 with their installed capacity. Komag is working toward it: it added a third 1.2 million disks-per-year line in April, has begun a fourth, and is placing orders for equipment for fifth and sixth lines. □

After-market demand heats up for 3.5-inch drives



Source: Dataquest Inc.

ELECTRONIC PUBLISHING

From Gutenberg to PageMaker in five easy centuries

The market for corporate electronic publishing systems is just getting under way in Europe but prospects are promising

By Jack Gee

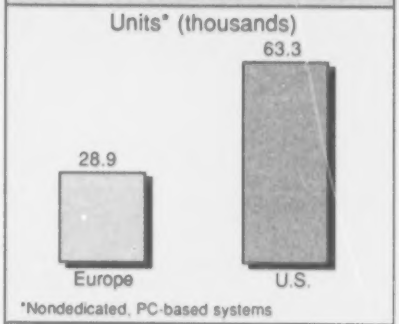
In the early 1980s, Americans flocked to their local stores to buy microcomputers. Today, many of the acquisitions from that stampede gather dust in attics and closets. But, while the micro craze swept the United States, the Europeans adopted a wait-and-see approach. In the next few years, we could witness similar contrasting behavior patterns in corporate electronic publishing systems (CEPS).

Slow to be convinced that the personal computer was here to stay, Europe has now become a stable, steady market. It is also a market unmarked by the disenchantment among users which, in the United States, sent some PC manufacturers clamoring for Chapter 11 and mothballed semiconductor foundries. The same cautious development trends are likely to emerge in the European market for CEPS hardware and software packages.

However, Europeans do not underestimate the potential of these systems, which combine a high-definition monitor, keyboard/graphics tablet, processor, disk storage and laser printer. "This lively interest is not surprising when you remember that the printing press was invented in Germany by Johannes Gutenberg over 500 years ago," says Yves Stern, president of Italiques, a French computerized typesetting company which is also a partner in a desktop publishing venture.

This year, European businesses are likely to spend about $150 million on desktop publishing, according to Wharton Information Systems, a market study group based in London. And even with Europe's slow awakening to CEPS' potential, Wharton says that CEPS looks set to capture a $1.5 billion European market with sales of over 140,000 systems by 1990.

In 1986 Europe ran second to the U.S. in CEPS



Source: Dataquest Inc.

As with the PC five or six years ago, Europe has initially turned to the United States for much of its CEPS hardware and software. But, since leading European microcomputer manufacturers can offer high-definition screens, dependence on the states for this hardware is no longer as strong as it was for the PC.

The Europeans are also considerably less dependent on American CEPS software than they were for the application packages for the first business microcomputers. However, Apple Computer Inc. is trying to repeat its U.S. success and conquer Europe's CEPS market with the Macintosh PC in association with its own Laser Writer printer and Aldus Corp.'s PageMaker publishing software.

Mac attack

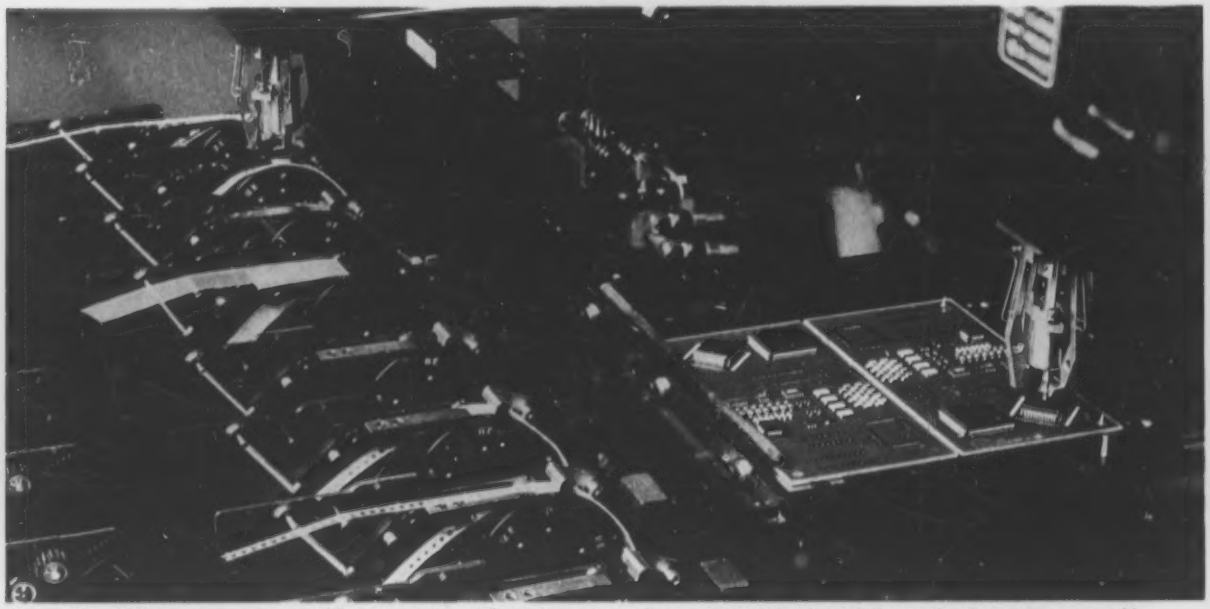
According to Intelligent Electronics, the European microcomputer market research firm which was recently acquired by Dataquest Inc., Europe bought 15,000 Macintoshes last year with as many CEPS software packages — and half of these were Pagemakers. Gordon Curran, associate director of Intelligent Electronics, which has kept its name under U.S. ownership, says: "During the first half of 1987, as many desktop publishing packages have been sold in Europe as in the whole of 1986."

In contrast with the advent of the PC, when the United States was slow to produce application software in European languages, U.S. suppliers have hastened to customize their CEPS programs so as not to lose this market to Europe's own software houses. Alan Clemmetsen, associate director of Dataquest's European Printer Industry Service, says: "A race is on between the U.S. customized packages and the locally produced software in Europe."

But this contest demands stamina. Jo Cohen, a desktop publishing consultant in Paris says: "Whether it's the Americans adapting their software for Europe's markets or the Europeans writing their own, page description language is extremely difficult, time consuming and costly. Our medley of accents and varying rules about hyphenation make this task particularly complex."

Europeans' suspicion of what they regard as an impulsive American attitude toward new gadgets partly explains their relatively slow acceptance of CEPS. Another reason is Apple's failure in Europe — except in France — to match the impact which its successive generations of PCs have had in the United States.

Dataquest's Clemmetsen predicts that CEPS will become a genuine force in Europe only when IBM clearly commits itself to this market. He says: "Now that PageMaker and Xerox's Ventura desktop publishing packages have been adapted for the IBM PC, we can expect rapid growth. But, in contrast with its strategy in the U.S., IBM has not yet declared its hand in CEPS in Europe." □



WITH THE YEN hovering at about 150 to the dollar, U.S. equipment carries an attractive price relative to the Japanese competition

EQUIPMENT

Dynapert and Universal go for the Asian gold

The largest manufacturers of PCB assembly gear are shifting their perspective to include the Far East

By Mark Mehler

The appreciation of the yen relative to the dollar has given U.S. suppliers of printed circuit board assembly equipment a window of opportunity into Hong Kong, Korea, Singapore and Taiwan, where much of the world's consumer electronics assembly occurs. With the yen hovering at about 150 to the dollar, and expected to stay at that level for some time, U.S. equipment — both through-hole component inserters and surface mount component (SMC) pick-and-place machines — carries an attractive price relative to the Japanese competition.

In an attempt to grab that opportunity, the two largest U.S. assembly equipment makers, Universal Instruments Corp. of Binghamton, N.Y., and Emhart Corp.'s Dynapert Division in Beverly, Mass., which together control close to half of the estimated $450 million worldwide merchant market, are introducing a flurry of new products aimed at meeting the Far East requirement for high speed, accuracy and reliability.

Asia is where the action is because, as many industry experts say, the "Five Dragons" of the Far East — Hong Kong, Japan, Korea, South Korea and Taiwan — accounted for about 45% of the $450 million in PCB assembly equipment shipments in 1986. The United States only accounted for about 35%, experts say, followed by Europe at 15%, and the rest of the world, primarily Brazil and Mexico, with 5%.

Among the seven new products unveiled by Universal so far this year is a surface-mount chip placement system designed to turn out high-volume boards for consumer toys and appliances. Dan Mortland, Universal's director of product marketing, says several additional products will also be rolled out soon, all targeting the Pacific Rim market.

Meanwhile, Dynapert, which has had a large share of the Asian market for through-hole insertion equipment, sees the present currency situation as its chance to sell its first SMC placement systems in that part of the world. Toward that end, the company recently introduced a high-speed placement machine.

The two U.S. leaders, of course, have plenty of competition. Charles-

Photograph courtesy Universal Instruments

Henri Mangin, an industry analyst in Old Lyme, Conn., says at least 75% of the Pacific Rim market consists of high-speed "chip shooters," made by Fuji, Panasonic, TDK and others. Until recently, these systems had limited capabilities, primarily in handling resistors and other commodity parts. However, the new generation of Japanese equipment reportedly has the flexibility to mount small-outline integrated circuits (SOICs) and other sophisticated surface mount devices. Panasonic's MK-2 machine, for example, can place jellybean chips and all SOICs on 8mm-to-24mm tape, at speeds of up to 18,000 parts per hour.

Mangin also says the old claim that Japanese equipment lacks flexibility no longer is valid. Although he agrees that the rise of the yen gives (Dynapert and Universal) an edge, he doesn't see them challenging Japanese domination of the roughly $120 million to $130 million Asian market for SMC systems.

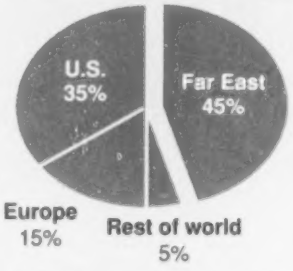
"Regardless of the value of the dollar, the U.S. companies are only just entering the market, and they have a big lead to overcome," says Mangin. "It's [analogous] to cars. A million people buy Mercedes each year. The fact that Cadillac is a little cheaper doesn't mean it will beat Mercedes at its own game."

At least one large user concurs with that assessment. Robert Todd, chairman and president of Flextronics Inc., a contract assembler with manufacturing facilities in Hong Kong, Singapore and the United States, says his firm just bought two Fuji high-speed SMC pick-and-place machines for its Asian operations. "In our business you don't buy the first machine," says Todd. He adds that before Asian contractors or original equipment manufacturers "feel comfortable" with U.S. equipment, American suppliers must build solid service presence in Asia.

Asian agents

Universal's Dan Mortland says that the company has opened a support office in Hong Kong to supplement its Japanese representative, Hakuto, and it is considering additional sites for new service facilities. "Hakuto has been very strong as a sales agent," says Mortland, "but we recognize the need to offer all the support we can." Mortland says that while the rising yen has given Universal the impetus to pursue the traditional Japanese niche in high-volume consumer electronics assembly, in a broader sense the Asian thrust is part of a corporate commitment to compete more effectively in the global marketplace. In the past year, according to Mortland, 60% of Universal revenue was derived from offshore sources. In past years, offshore customers accounted for 40% or less.

Worldwide merchant market for printed circuit assembly equipment



Total 1986 market: $450 million

Source: Industry estimates

Dynapert and Universal are increasing their penetration of the Far Eastern market

Christopher Sears, product manager for through-hole assembly equipment at Dynapert, insists that the Massachusetts company has been the leader in the Far East high-volume through-hole market since the early 1980s, and now has about 60% of that business. Dynapert sells direct in Japan through its own subsidiary there, and Sears says that presence, coupled with the "currency impact," will help Dynapert launch its new 14,000-parts-per-hour SMC machine in Korea and the rest of the Pacific Rim.

"Now that onshore Japan is dead, we're looking at Korea and Taiwan as our biggest growth markets," says Sears, adding that the Far East already delivers more than half of Dynapert's total revenue.

Sears says Dynapert's new pick-and-place machine, at about $300,000, is cost-competitive with the Japanese approach, which involves selling "broken apart" machines, one for dedicated applications (resistors, capacitors), the other for lower speed placement of ICs. "We still see the Japanese competing in a niche market for simple systems that do a finite range of parts with minimum moving mechanisms, and do it well," says Mortland.

The two industry leaders, however, will get an argument, at least, from Michael Ruiz, western regional sales manager for Panasonic's Industrial Equipment Division. Ruiz points to his company's success at penetrating leading-edge customers in the United States. Apple Computer Inc., IBM, Motorola Inc., Rockwell Interna-

U.S.-MADE EQUIPMENT, such as Dynapert's newest surface-mount insertion machine, is targeted at the Pacific Rim market

tional Corp. and Xerox Corp., all of which are acquiring high-speed surface mount capability for strategic purposes, are Panasonic customers, says Ruiz.

The U.S. equipment makers have their own niche in high-reliability machines for mounting advanced circuits, and midrange flexible systems, Ruiz concedes. But in the fastest-growing market for flexible, high-speed systems, he argues, it is the U.S. suppliers that face the "credibility gap" in technology.

"The yen levels may not come back and this presents them with a window in Asia," Ruiz adds, "but how long that window will last is another question. The U.S. companies are at the beginning of a long learning curve. When they've completed it, will the opportunity still exist?"

Mehler is a New York-based business writer.

TEST

The lure of the low-end board test market

Competition is making medium-sized ATE companies look to the low end of the printed circuit board test market

By David Card

Price wars in the crowded middle tier of the automatic test equipment market are forcing some suppliers to look for opportunities in the low-cost board test business. But the field is already crowded.

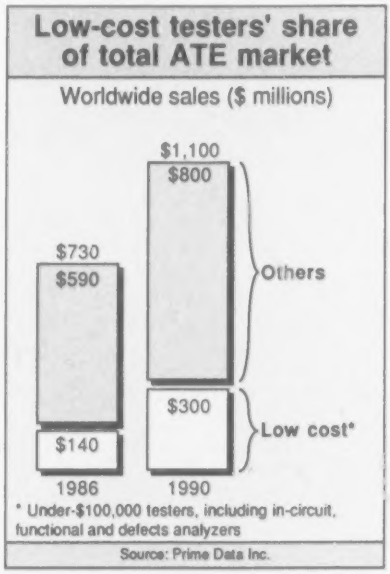
British supplier Marconi Instruments Ltd. has more or less given up on the midrange U.S. ATE market. "To compete, you have to give [the equipment] away," says William Bean, vice president of Marconi's U.S. sales arm in Allendale, N.J. "You start out saying [your product] costs $150,000 but then, magically, another demo model is suddenly available for $70,000."

"There will still be a middle market for in-circuit testers," agrees Craig Pynn, marketing vice president of Zehntel Inc., Walnut Creek, Calif., but "it won't be a growing market."

Currently, in-circuit testers, which test the individual components of a circuit board, are in the middle of the ATE price spectrum. At the high end are combinational testers, costing half a million dollars and up; they combine in-circuit techniques with functional testing of the board. At the low end are cheap functional testers, sort of pass/fail systems, and manufacturing defects analyzers (MDAs). Defects analyzers catch short or open circuits.

Marconi has a line of in-circuit testers that has been largely unsuccessful in the United States, according to Roy Lester, general manager of Marconi's Automation Division in St. Albans, England. "What we've done in the U.S. is concentrate on Checkmate," he says, referring to Marconi's 2-year-old low-end tester. Checkmate is a modular system that can be configured as a cheap in-circuit or functional tester. It sells for around $65,000, and Marconi has sold $9 million worth, Lester says. This year, the company also introduced a defects analyzer.

Lester says that Marconi tried a big in-circuit push in the United States a few years ago but was clobbered by the three-headed club of "competition, recession and oversaturation." As a result, Marconi only sold about 85 testers in the states. "There is still some residual business, but now we are focusing on a market where there is less competition," Lester says.



Plenty of products

Meanwhile, that market is already filling up with competitors. One is Zehntel's new low-end in-circuit tester, the 1800. Zehntel's Pynn says that it will face competition from three areas. He thinks customers will choose either MDAs or what he calls the "benchtop" testers of Marconi and others. Or they'll choose stripped-down models from the bigger in-circuit ATE companies, such as GenRad Inc. and Hewlett-Packard Co. — or Zehntel for that matter. But, Pynn says that Zehntel changed the architecture completely for the 1800.

If Zehntel's customers can use custom chips on their boards, then why couldn't Zehntel? Pynn asks. A redesign, incorporating custom chips from National Semiconductor Corp. got a $23 dollar driver/receiver system, hundreds of which populate an in-circuit tester, down to $14, Pynn says. Still, the 1800 is less flexible in terms of what families of logic it can handle. "We've always offered lots of options," Pynn says. "But this one's price list fits on a single page. Sort of like the Model T — everything you need, you get. Everything else, you don't need."

Zehntel will have to change its style of selling, since the 1800's lower gross margins will not support the "traditional 18 sales calls" common to the ATE business, according to Pynn. He is inaugurating a telemarketing campaign, and hopes to leverage tester sales from a videotape and even a book that he wrote on test strategies. It is a whole new world for Zehntel. "We're going to try to bring some of the economies of scale of the instruments business," Pynn says. "It's really just an instrument."

There are, of course, some very established instrumentation companies at the low end already. John Fluke Manufacturing Co. of Everett, Wash., sells its 9000 series of modular, functional testers into the production test floor where ATE rules. Hugo Draye, a Fluke marketing group manager, says that the 9000 is generally used as a "trouble-shooter," rather than a production tester. After a conventional tester fails a board, the $30,000

Fluke machine is used to track down the failure.

Fluke also makes a defects analyzer, but Draye says that the company's efforts are concentrated on the new generation of the 9000 series, the 9100, rather than on the 4-year-old analyzer. "We want to maximize the efficiency of our product line," Draye says, rather than focus on any one branch of ATE. The defects analyzer, incidentally, has not been exactly a runaway success for Fluke, Draye admits. He says that he only sells 15 to 18 analyzers in any given year.

Fluke has also failed to penetrate the Japanese market with its defects analyzer, even though MDAs in general are more popular in Japan than in the United States, Draye says. But in reference to the U.S. market, he says "MDAs are falling back into a favorable light." Draye continues: "The other thing that will help the MDA market is the swing back to functional test at the high end." Combinational/functional testers, Draye reasons, are so expensive that companies will want to catch faults to avoid tying up the big machines at the end of the line. MDAs can be used to diagnose the failures for repair.

Draye suggests that companies wanting a low-cost test solution should buy the 9100 for testing boards during the development stage of a product. Then, when they ramp up production, they can add a number of low-cost testers rather than starting from the beginning with one expensive ATE system geared for high-volume testing. That way, they can depreciate the cost of one cheap tester during the development time when they have no product revenue, and add capacity when they do.

Start-ups galore

Three-year-old Support Technologies Inc. of Portland, Ore., originally cast itself as a company in the service tester business. But half of its $2.5 million in sales last year were from manufacturing, says Support president Alfred Hahn. "We're officially at the low end of the regular ATE business," Hahn says of his functional tester. The fixture that Support sells to allow boards to plug into its tester is the same one GenRad uses, from Pylon Co., Hahn says.

There is one thing Support is doing differently than the conventional ATE companies. "We're moving this product upscale," Hahn says. With the fixtures suitable for volume testing, Support's testers can cost $50,000 to $80,000.

As Support is aimed primarily at testing digital boards, Summation Inc. of Kirkland, Wash., was aimed at testing analog boards. But, this year, the company added digital capability that should bring it head-to-head with Fluke, Marconi and Support. Still, Summation's marketing vice president, Michael Thiemann, says his company is really in the custom-ATE market, replacing racks of instruments rather than ATE systems.

Not coincidentally, that is one of the markets Zehntel is after with its new tester, according to Zehntel's Pynn. That and "smaller companies that don't want to invest all those bucks in ATE," Pynn says. Summation's Thiemann seems to echo Pynn: Customers "turn to us when they can't buy — or buy in a cost-effective way — a turnkey ATE system." □

CAD

Upward mobility in circuit board design

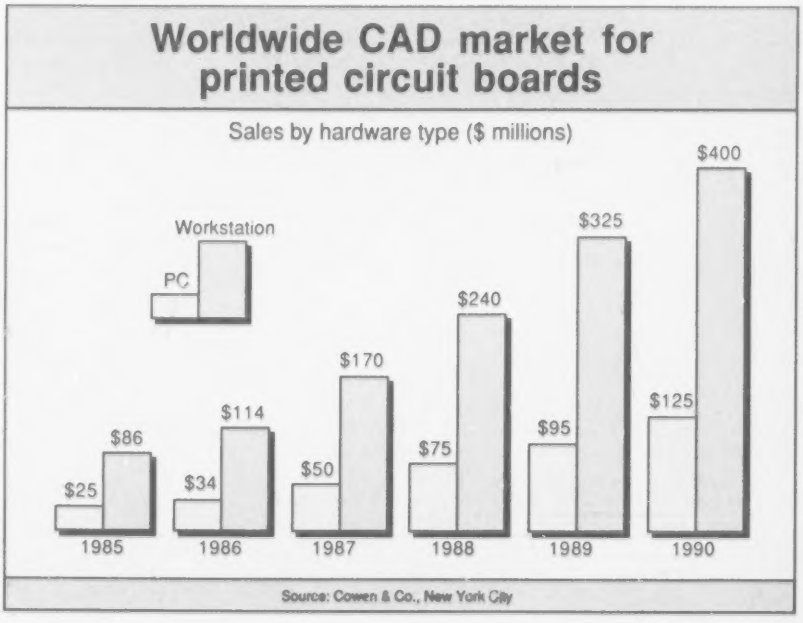
Workstation price wars are making PCB CAD vendors seek alternative hardware solutions at the low end

By David Card

A handful of smaller companies have made their fortunes riding the coattails of the IBM personal computer. Typically, these firms sold $10,000 circuit-board design software to engineers unwilling to fork over the $50,000 to $100,000 that it cost for a 32-bit workstation system. But now workstations are nearly as cheap as 16-bit PCs, and computer-aided engineering and design (CAE/CAD) software packages can be had for about $500. What's a company to do?

Move upscale. Companies in the $5 million to $20 million range — companies like CASE Technology Inc., FutureNet Corp. and Viewlogic Systems Inc. — are jumping on the bigger hardware. Actually, jumping is not exactly an accurate term. Being dragged grudgingly is more like it.

"We've had our noses rubbed into the fact that customers want a broad spectrum of products," complains Bruce Gladstone, executive vice president of FutureNet in Chats-



worth, Calif. FutureNet was one of the first to offer PC software for design, back in 1983. Early this year, the company rewrote its software to run on VAXstation workstations from Digital Equipment Corp.

"We were getting weary of telling people that you can buy the PC AT with the same performance as the VAXstation, so now we're offering the VAXstation," Gladstone says. He claims that in reality, the performance is not much different, but the customer's "perception is reality." Other FutureNet execs say that the DEC hardware opens doors at some larger companies that would not look at a PC.

"Some customers believe that a workstation is the only way to do CAE," says Alain Hanover, president of Viewlogic in Marlboro, Mass., "They have a mental block." Viewlogic, too, worked its way up to DEC.

Workstation wars

The new pricing structure for workstations makes them an attractive alternative to the PC. In April, workstation maker Sun Microsystems Inc. slashed the price of its entry-level machine from $7,995 to $4,995, initiating a price war that Apollo Computer Inc., DEC and Hewlett-Packard Co. soon entered. "The PC has a better price/performance ratio, even with all the drastic price cutting," Hanover maintains. But he is perfectly realistic about customer demand: "If people are willing to spend it, we'll take their money." Hanover says that he added DEC to his IBM PC base because "we wanted to represent the two largest computer vendors out there in design automation. Apollo is No. 3 and Sun a distant fourth."

With workstations now as cheap as 16-bit personal computers, it makes sense to write PCB software for higher powered CAD engines

Mountain View, California-based CASE Technology claims it was always a workstation supporter, according to president Kevin Kerns. Computer-intensive operations such as automatic chip placement and logic simulation fit the bigger machines, while schematic entry, the first step of the design process, ran on the PC. Kerns admits that 70% of CASE's business has always been for PC software.

CASE recently started offering schematic entry for DEC and Sun hardware. The transition was easy, Kerns says, because CASE originally wrote its software to run under the Unix operating system that controls most workstations. For PCs, CASE translated the software into DOS, the PC operating system of choice.

Personal CAD Systems Inc. of San Jose is one company that does not want to abandon DOS, according to president Douglas Stone. In fact, last year P-CAD aborted an attempt to get into the Unix business. Now Stone says that he might look at Unix again, particularly for Apple Computer Inc.'s new Macintosh II personal computer. But right now, he does not want to tread on the turf of the CAE workstation suppliers, particularly market leader Mentor Graphics Corp., whose software runs mostly on Apollo machines.

Stone wonders about his competitors' strategies. "What are they going to do, compete against Mentor? On Mentor's own terms? Without a DOS platform?" Stone asks. "The Unix-based people are going to come back with a networking strategy that will just plaster them." CASE, FutureNet and Viewlogic all insist that they have not abandoned DOS.

Stone estimates that IBM's in-

The CAE companies on PC software: No thanks

The CAE workstation companies are relative newcomers to printed circuit board CAD. But they, too, believe that the new pricing structure for workstations may signal an end to market penetration by PCs in the design business.

"We have no pressures to be on the PC at all," says Alberto Jimenez, vice president of Mentor Graphics Corp.'s San Jose Automated Layout Division. Mentor resells workstations from Apollo Computer Inc. Although Mentor will sell PC software to customers, "We actually try our best to discourage them." Mentor's PC offerings were a quick-fix defensive move, Jimenez admits. "At the time, it was the right thing to do. We retained some customers by having it," he says.

"We have no need at all to drive the product down into the DOS world," echoes Joseph Prang, marketing vice president of Valid Logic Systems Inc. in San Jose. The bulk of Valid's software runs on workstations from Digital Equipment Corp. and Sun Microsystems Inc. Valid sells PC software, but it runs under Unix via a coprocessor. Valid's customers design large, complex boards, Prang insists. "Those are tough problems, not the ones you can fit into smaller DOS systems." Also, too many operating systems make for too much effort. "It is a key thing to keep the operating systems and compilers down to a reasonable level," Prang says. "That is one reason why we don't want to screw around with DOS."

General Electric Co.'s Calma subsidiary has long been a CAD player, but mostly for chip design. Calma's senior vice president for electronic design, Bruce Gregory, scoffs at the PC. "Why would I be interested in that? The workstation companies will have overlapped the PC in price in six months if not by the end of the year," he says. "I don't know how you'll be able to tell the difference pretty soon." Calma did sell a customized PC, but now is a reaffirmed believer in Apollo workstations. "We will ride the wave of the workstations," Gregory says. "We're not going to go into the mail-order business — our business is premium software."

"Everyone is interested in CAD/CAE on a personal computer, but at what stage? Design? Verification?" asks Larry Potter, in charge of marketing electronics design systems for Hewlett-Packard Co.'s Fort Collins, Colo., office. HP sells software for its Vectra PC, "but not for much longer," Potter says. That may send a few shivers down Personal CAD Systems' spine, since HP resells P-CAD software. HP's preferred hardware is its own Unix workstation. "I don't think much design automation is going to be done under DOS," Potter says. □

stalled base of PCs in engineering situations is roughly about 500,000 units. Apollo and Sun say that they have shipped about 40,000 workstations each. Stone will let IBM solve P-CAD's migration from DOS to Unix through IBM's promised OS/2 and Windows environment, which will eventually allow multiple programs — possibly under multiple operating systems — to show up on one screen.

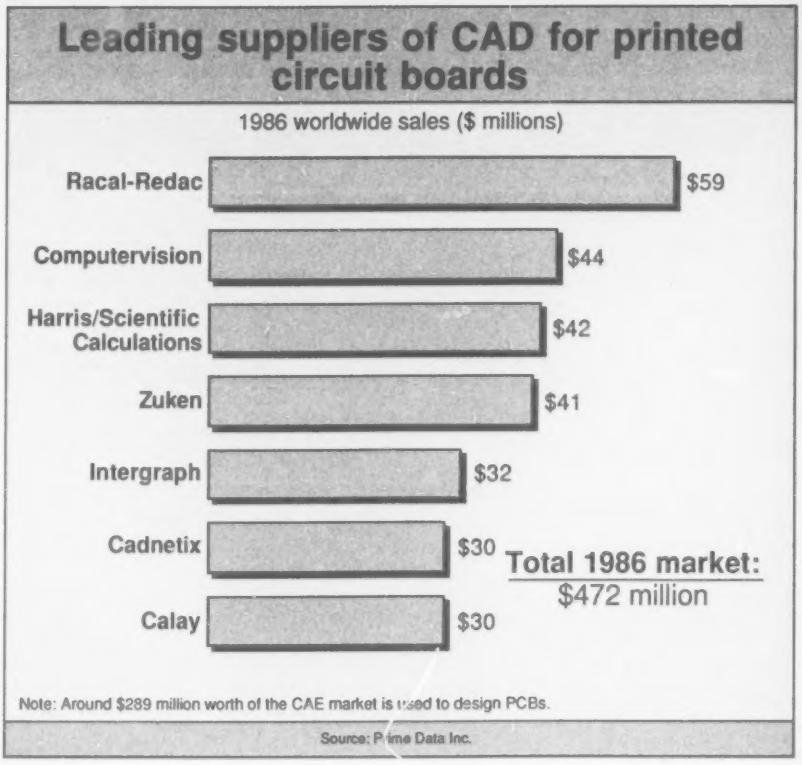
From the depths

Stone has his own theory about why his rivals are moving up to supply software for the more powerful platforms. "They're afraid of the low-end competition," he says. Stone and his competitors sell through a combination of manufacturer's reps, distributors and direct sales. P-CAD is taking what Stone admits is a risky step by pulling out of the rep chain and setting up a value-added reseller system. Direct sales are expensive, Stone says, demanding the higher gross margins of the pricier workstation software.

Ironically, the PC-based software makers are facing the same pressure from below that they once caused for the CAE workstation companies. The new low-end sharks, including Orcad Systems Corp. of Hillsboro, Ore., sell $500 software packages that users can copy freely. The design software is usually a cut-down — but not by much — version of schematic capture, a sort of high-end drafting tool for making drawings of circuit boards. Sometimes these companies sell through the mail.

"We've got 'em by the short hairs," crows Orcad chairman John Durbetaki. Starting through the mail, Durbetaki claims his company has an installed base of 6,000 units, pretty close to that of the bigger PC companies. "We've broken out of the mold of mail-order software," he says. "Our growth is attributable to our rep organization." Durbetaki says that he has happily picked up some of P-CAD's former reps and saved a lot in training expenses.

Viewlogic's Hanover does admit: "We lose a sale here and there" to the low-cost packages. But, he says, Viewlogic is selling schematic entry in part on the strength of its integration to other applications, including simulation. He denies that low-end pressure forced him onto the bigger hardware. "It expands the market," he says of the low-cost packages, spreading out the availability of design software to more engineers. Once customers try out design automation, he says, they will want more, and appreciate the upgrade path Viewlogic offers.



Downward mobility

Meanwhile, CAD companies that started on minicomputers and workstations are moving some of their software onto PCs. Peter Shaw, president of Calay Systems Inc. in Irvine, Calif., just started selling PC software to integrate with a workstation Calay has been building for years. "Give us time," Shaw says. Likewise, Boulder, Colorado-based Cadnetix Corp. is adding PCs to its homegrown workstation offerings. Vice president O'Neil Feltman says that although Cadnetix has been selling PC software for only eight months, in another few months its installed PC units will outnumber its workstation units two-to-one. Both companies position their workstations as a networked heavy-duty computer for the PC entry seats to share.

Racal-Redac Ltd. of Tewkesbury, England, has been migrating from DEC minicomputers to workstations and PCs for some time. Chief technical officer Richard Barrett says that PC software accounts for 20% of Redac's sales. "We do tend to treat it as a different part of the business," Barrett says. Redac, for instance, does not sell the PC software direct anymore, as it does with its more expensive packages for workstations from Apollo, DEC and Sun. "I'm hard pressed to see how you can do that and do it profitably," he says. "Like any PC product, you can't sell it by knocking on somebody's door. One sales call is still profitable, but by the time you make two calls, you're selling at a loss."

Earrett admits that Redac would rather sell workstation software. "To be quite frank, we're not going to try to sell 50 or 100 of them to Rockwell or Hughes," he says of Redac's software packages for PCs. Now that IBM's latest top of the line personal computer, the as yet undelivered PS/2 80, carries a 32-bit chip, things might be different. "Engineers, will they continue to buy PCs or will they switch to workstations? I don't know," Barrett puzzles. "The top-end PCs and the bottom-end workstations sure as hell don't have a difference in pricing."

And what does IBM think about all this? Well, it does not have any of its board design software running on the PC. Robert Tiel, IBM's director for marketing of electronic design in Valhalla, N.Y., says that IBM is in the process of moving its software onto its Unix workstation, the RT PC. In fact, he admits that the slow pace of that effort is the main reason for the RT's admittedly weak sales. "For the present time, one can anticipate that things put on the RT will show up on the PS/2," Tiel says. □

Excellent Companies

Our readers choose the best companies in the electronics industry

By Linda Stallmann and Nancy McSharry

AMP
AT&T
Apple Computer
Avnet
DEC
General Electric
Intel
Raytheon
Seagate Technology
Sun Microsystems

EXCELLENT COMPANIES

COMPONENTS

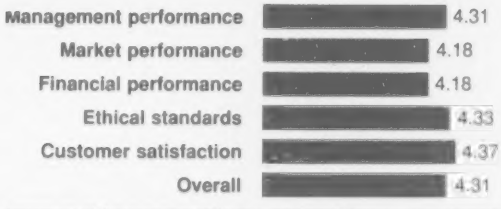
AMP Inc.

Harrisburg, Pa.

NOTABLE ACHIEVEMENTS

- **Opened first plants in Switzerland , South Korea and Taiwan, and second plants in Brazil and Singapore will begin operation in late 1987.**
- **Benefited from strong international currency gains: International sales increased 9% in local currencies – 36% in U.S. dollars.**
- **Created NETCON Division to focus on an active networking/customer premise wiring market.**

STANDARDS OF EXCELLENCE



5 = Excellent, 4 = Good, 3 = Fair

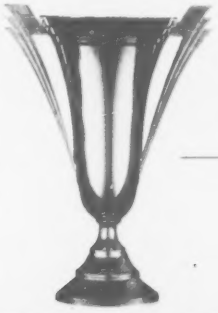
AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1986	1985	Change
Sales ($ thousands)	$1,933,055	$1,636,112	+18.1%
Net income ($ thousands)	$164,345	$108,003	+52.2%
Net income/sales	8.5%	6.6%	—
Cost of sales/sales	56.8%	58.6%	—
R&D/sales	8.8%	9.8%	—
Marketing, G&A/sales	18.7%	19.5%	—
Capital expenditures/sales	7.8%	12.1%	—
Number of employees	21,800	22,800	-4.4%
Sales per employee	$88,672	$71,759	+23.6%
Net income per employee	$7,539	$4,737	+59.1%
Current ratio	1.98	1.86	—
Debt/equity ratio	0.041	0.036	—

Fiscal year ending December 31.

	MOST RECENT SIX MONTHS		
	1987	1986	Change
Sales ($ thousands)	$1,111,724	$945,350	+17.6%
Net income ($ thousands)	$116,650	$75,939	+53.6%

Six months ending June 30.



COMMUNICATIONS

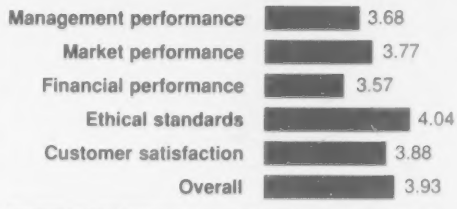
AT&T Co.

New York, N.Y.

NOTABLE ACHIEVEMENTS

- **Long distance revenue remained strong.**
- **Merged various groups into AT&T Federal Systems which now handles all government products and services.**
- **Moved aggressively into international markets; making equity investments and marketing agreements with leading European and Far Eastern companies.**

STANDARDS OF EXCELLENCE



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AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1986	1985	Change
Sales ($ thousands)	$34,087,000	$34,417,000	-1.0%
Net income ($ thousands)	$139,000	$1,557,000	-91.1%
Net income/sales	0.4%	4.5%	—
Cost of sales/sales	53.5%	52.6%	—
R&D/sales	6.7%	6.5%	—
Marketing, G&A/sales	32.5%	32.3%	—
Capital expenditures/sales	10.6%	12.1%	—
Number of employees	316,900	337,600	-6.1%
Sales per employee	$107,564	$101,946	+5.5%
Net income per employee	$439	$4,612	-90.5%
Current ratio	1.39	1.46	—
Debt/equity ratio	0.51	0.48	—

Fiscal year ending December 31.

	MOST RECENT SIX MONTHS		
	1987	1986	Change
Sales ($ thousands)	$16,522,000	$17,131,000	-3.6%
Net income ($ thousands)	$1,041,000	$776,000	+34.1%

Six months ending June 30.

EXCELLENT COMPANIES

DESKTOP COMPUTERS

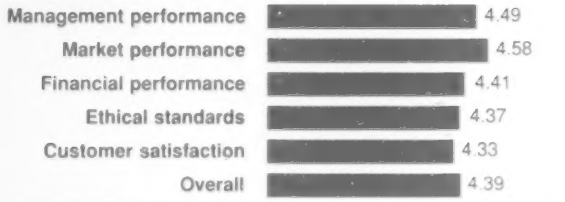
Apple Computer Inc.

Cupertino, Calif.

NOTABLE ACHIEVEMENTS

- **Doubled previous record net income, despite no growth in revenue.**
- **Completed reorganization of company according to function as opposed to product lines.**
- **Increased unit sales of higher-end Macintosh computers and certain peripherals, which offset the effects of reduced sales of lower-end Apple II computers.**

STANDARDS OF EXCELLENCE



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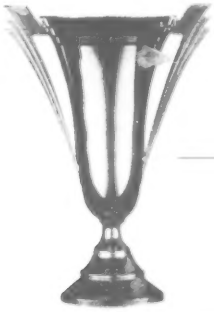
AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1986	1985	Change
Sales ($ thousands)	$1,901,898	$1,918,280	-0.9%
Net income ($ thousands)	$153,965	$61,223	+151.5%
Net income/sales	8.1%	3.2%	—
Cost of sales/sales	46.9%	58.3%	—
R&D/sales	6.7%	3.8%	—
Marketing, G&A/sales	32.0%	30.7%	—
Capital expenditures/sales	3.5%	2.8%	—
Number of employees	5,600	4,300	+30.2%
Sales per employee	$339,625	$446,112	-23.9%
Net income per employee	$27,493	$14,238	+93.1%
Current ratio	3.17	2.78	—
Debt/equity ratio	No long-term debt		—

Fiscal year ending September 26

	MOST RECENT NINE MONTHS		
	1987	1986	Change
Sales ($ thousands)	$1,874,644	$1,391,112	+34.8%
Net income ($ thousands)	$145,279	$121,070	+20.0%

Nine months ending June 26



DISTRIBUTORS

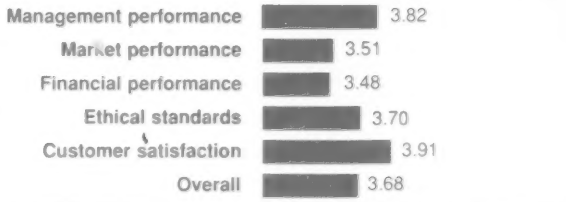
Avnet Inc.

New York, N.Y.

NOTABLE ACHIEVEMENTS

- **Has expanded its relation with Digital Equipment Corp. beyond boards/peripherals to DEC's entire product line (except high-end mainframes).**
- **Entered into new markets such as ASIC design centers and focused more on computer systems.**
- **Formed strategic alliances with a number of companies including N.V. Philips, M/A-COM and Motorola.**

STANDARDS OF EXCELLENCE



5 = Excellent, 4 = Good, 3 = Fair

AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1986	1985	Change
Sales ($ thousands)	$1,426,768	$1,542,441	-7.5%
Net income ($ thousands)	$23,857	$49,384	-51.7%
Net income/sales	1.7%	3.2%	—
Cost of sales/sales	74.6%	72.8%	—
R&D/sales	0.0%	0.0%	—
Marketing, G&A/sales	21.7%	20.4%	—
Capital expenditures/sales	1.6%	2.6%	—
Number of employees	9,250	12,000	-22.9%
Sales per employee	$154,245	$128,537	+20.0%
Net income per employee	$2,579	$4,115	-37.3%
Current ratio	5.17	4.71	—
Debt/equity ratio	0.17	0.18	—

Fiscal year ending June 30

	MOST RECENT NINE MONTHS		
	1987	1986	Change
Sales ($ thousands)	$1,117,800	$1,039,700	+7.5%
Net income ($ thousands)	$15,600	$24,100	-35.3%

Nine months ending March 27

EXCELLENT COMPANIES

COMPUTERS

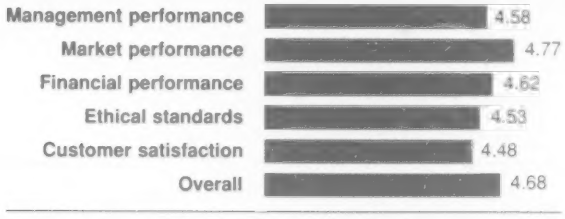
Digital Equipment Corp.

Maynard, Mass.

NOTABLE ACHIEVEMENTS

- **Is approaching $10 billion in revenue which brings DEC to about one-fifth the size of IBM, up from about one-seventh two years ago.**
- **Has successfully sold the concept of networked computers operating in a uniform software environment.**
- **Made inroads into banking and investment firms that traditionally buy from IBM.**

STANDARDS OF EXCELLENCE

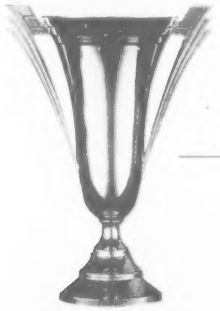


5 = Excellent, 4 = Good, 3 = Fair

AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1987	1986	Change
Sales ($ thousands)	$9,389,444	$7,590,357	+23.7%
Net income ($ thousands)	$1,137,435	$617,420	+84.2%
Net income/sales	12.1%	8.1%	—
Cost of sales/sales	48.1%	56.4%	—
R&D/sales	10.8%	10.7%	—
Marketing, G&A/sales	24.0%	21.9%	—
Capital expenditures/sales	8.0%	7.4%	—
Number of employees	110,500	94,700	+16.7%
Sales per employee	$84,972	$80,152	+6.0%
Net income per employee	$10,294	$6,520	+57.9%
Current ratio	3.40	4.90	—
Debt/equity ratio	0.04	0.06	—

Fiscal year ending June 27



DIVERSIFIED ELECTRONICS

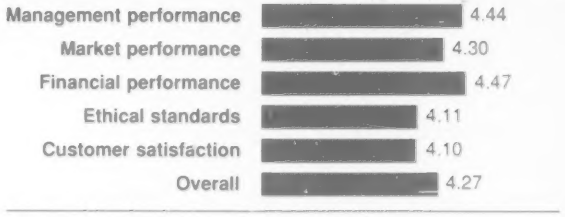
General Electric Co.

Fairfield, Conn.

NOTABLE ACHIEVEMENTS

- **In the biggest non-oil merger in history, GE paid $6.4 billion for RCA Corp.**
- **Sold its consumer electronics business to Thomson SA, and agreed to take over Thomson's medical equipment business.**
- **In factory automation, GE formed a 50-50 joint venture with Fanuc of Japan, called GE Fanuc Automation Corp.**

STANDARDS OF EXCELLENCE



5 = Excellent, 4 = Good, 3 = Fair

AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1986	1985	Change
Sales ($ thousands)	$36,725,000	$29,252,000	+25.5%
Net income ($ thousands)	$2,492,000	$2,277,000	+9.4%
Net income/sales	6.8%	7.8%	—
Cost of sales/sales	71.3%	71.3%	—
R&D/sales	3.5%	3.7%	—
Marketing, G&A/sales	16.2%	15.7%	—
Capital expenditures/sales	5.6%	6.7%	—
Number of employees	359,000	292,000	+22.9%
Sales per employee	$102,298	$100,178	+2.1%
Net income per employee	$6,942	$7,798	-11.0%
Current ratio	1.25	1.41	—
Debt/equity ratio	.29	0.06	—

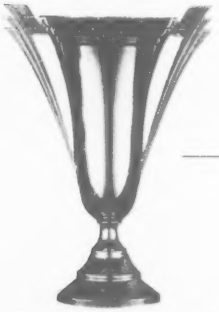
Fiscal year ending December 31

	MOST RECENT SIX MONTHS		
	1987	1986	Change
Sales ($ thousands)	$17,880,000	$13,670,000	+30.8%
Net income ($ thousands)	$1,344,000	$1,158,000	+16.1%

Six months ending June 26

Information for 1986 includes RCA results from June 1, 1986

EXCELLENT COMPANIES



SEMICONDUCTORS

Intel Corp.

Santa Clara, Calif.

NOTABLE ACHIEVEMENTS

- **Spent $228 million for R&D which was 18% of revenue, one of the highest in the industry.**
- **Introduced 74 new products including the 80386, a 32-bit microprocessor which IBM and Compaq are using in their latest PC products.**
- **Moved into the more promising markets such as ASICs, personal computer add-in boards and parallel-processing computers.**

STANDARDS OF EXCELLENCE

5 = Excellent, 4 = Good, 3 = Fair

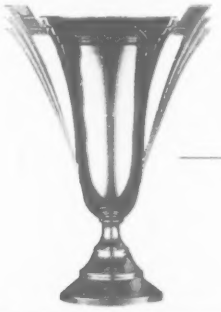
AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1986	1985	Change
Sales ($ thousands)	$1,265,011	$1,364,982	-7.3%
Net income ($ thousands)	-$183,284	$1,570	—
Net income/sales	-14.5%	0.1%	—
Cost of sales/sales	68.0%	69.1%	—
R&D/sales	18.0%	14.3%	—
Marketing, G&A/sales	24.6%	21.0%	—
Capital expenditures/sales	12.2%	17.3%	—
Number of employees	18,200	21,300	-14.6%
Sales per employee	$69,506	$64,084	+8.5%
Net income per employee	-$10,071	$74	—
Current ratio	2.73	3.34	—
Debt/equity ratio	0.22	0.19	—

Fiscal year ending December 27.

	MOST RECENT SIX MONTHS		
	1987	1986	Change
Sales ($ thousands)	$833,489	$585,232	+42.4%
Net income ($ thousands)	$72,004	-$42,533	—

Six months ending June 30.



MILITARY

Raytheon Co.

Lexington, Mass.

NOTABLE ACHIEVEMENTS

- **Defense electronics business continues strong: Sales to U.S. government increased 15.9%.**
- **Won two major second-source missile production awards in 1986, bringing the total second-source contracts for missiles programs to four.**
- **Entered into an agreement with Digital Equipment Corp. to produce an advanced family of computers for military use.**

STANDARDS OF EXCELLENCE

5 = Excellent, 4 = Good, 3 = Fair

AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1986	1985	Change
Sales ($ thousands)	$7,307,952	$6,408,537	+14.0%
Net income ($ thousands)	$393,205	$375,905	+4.6%
Net income/sales	5.4%	5.9%	—
Cost of sales/sales	80.0%	79.1%	—
R&D/sales	3.5%	4.1%	—
Marketing, G&A/sales	9.1%	9.2%	—
Capital expenditures/sales	4.7%	5.3%	—
Number of employees	75,000	73,000	+2.7%
Sales per employee	$97,439	$87,788	+11.0%
Net income per employee	$5,243	$5,149	+1.8%
Current ratio	1.29	1.30	—
Debt/equity ratio	0.02	0.04	—

Fiscal year ending December 31.

	MOST RECENT SIX MONTHS		
	1987	1986	Change
Sales ($ thousands)	$3,668,000	$3,553,000	+3.2%
Net income ($ thousands)	$212,600	$192,100	+10.7%

Six months ending June 26.

PERIPHERALS

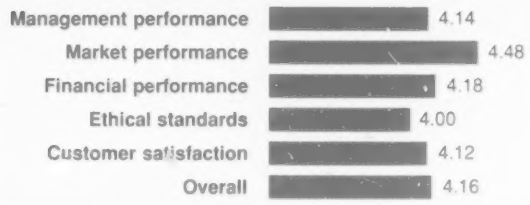
Seagate Technology

Scotts Valley, Calif.

NOTABLE ACHIEVEMENTS

- Fiscal revenue of $958 million was more than double that of 1986. Profits were four times higher.
- Received a contract from IBM to supply two new disk drive models. In 1987 IBM accounted for 24% of sales, down from 26% in 1986 and 49% in 1985.
- Signed an agreement with Hewlett-Packard to supply hard disk drives for use in HP's Vectra series computers. Valued at $20 million this year.

STANDARDS OF EXCELLENCE



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AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1987	1986	Change
Sales ($ thousands)	$958,065	$459,836	+108.3%
Net income ($ thousands)	$139,741	$34,536	+304.6%
Net income/sales	14.6%	7.5%	—
Cost of sales/sales	71.5%	80.4%	—
R&D/sales	3.5%	4.1%	—
Marketing, G&A/sales	6.2%	7.0%	—
Capital expenditures/sales	8.7%	8.4%	—
Number of employees	14,932	8,900	+67.8%
Sales per employee	$64,162	$51,667	+24.2%
Net income per employee	$9,358	$3,880	+141.2%
Current ratio	5.95	2.72	—
Debt/equity ratio*	0.85	0.07	—

Fiscal year ending June 30.

* Long-term debt includes convertible subordinated debentures of $287.5 million and other long-term debt and lease obligations of $14.3 million.

CAD/CAM/CAE

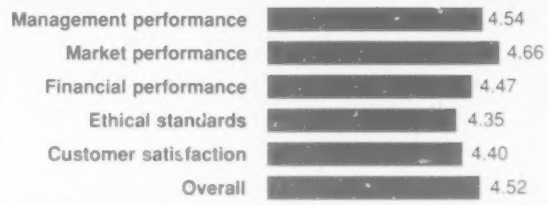
Sun Microsystems Inc.

Mountain View, Calif.

NOTABLE ACHIEVEMENTS

- Sales rose 156% to $538 million in fiscal 1987.
- Introduced a high-end 10 MIPS workstation (incorporating a Fujitsu RISC gate array); at the same time lowering the prices on its low-end workstations to under $5,000.
- Began manufacturing in a new 156,000 square foot facility; began expanding worldwide sales and support organizations.

STANDARDS OF EXCELLENCE



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AT A GLANCE

	FISCAL YEAR COMPARISONS		
	1987	1986	Change
Sales ($ thousands)	$537,537	$210,126	+155.8%
Net income ($ thousands)	$36,298	$11,189	+224.4%
Net income/sales	6.8%	5.3%	—
Cost of sales/sales	50.7%	48.5%	—
R&D/sales	12.9%	14.8%	—
Marketing, G&A/sales	23.6%	27.2%	—
Capital expenditures/sales	0.0%	17.2%	—
Number of employees	3,687	2,031	+81.5%
Sales per employee	$145,793	$103,459	+40.9%
Net income per employee	$9,845	$5,509	+78.7%
Current ratio	2.55	1.98	—
Debt/equity ratio	0.52	0.02	—

Fiscal year ending June 30.

COMMENT

Finding ways to improve Sino-American trade

A leading Chinese government official argues the case for relaxing U.S. export controls on technology

Since China implemented a policy of opening to the outside world in 1979, the nation's electronics industry has imported more than 1,800 items of advanced technology and equipment. These products have played an important role in accelerating the technical development of China's industry and have helped open a vast technical and product market to foreign enterprises.

Following the recent rapid growth of its national economy, China requires even more advanced electronics technology and better-quality electronics products. Hence, the scale of Sino-foreign cooperation in the electronics industry continues to expand.

Since the U.S. government has, in the past few years, taken some positive measures in relaxing its restrictions on technology sales to China, some progress has been made in Sino-U.S. trade and cooperation in the electronics field. But the pace of reducing restrictions on technology transfer to China is still too slow in the Chinese view, and the United States still imposes some restrictions on exports of advanced technology to China.

As a result, U.S. electronics companies have lost many potential opportunities to do business with China, even though they produce better products than some other foreign suppliers. For instance, the electronics production capacity of U.S. firms, generally speaking, is much stronger than that of Japan, but, during China's sixth five-year plan period (1981-1985), U.S. companies fulfilled only 20% of China's technology import needs, while Japanese firms supplied 60%. Worse still, in 1986, U.S. firms captured only about 10% of the business, while the Japanese took about 70%.

XIE GAOJUE

John Kilroy

Unnecessary fears

China understands that some U.S. government officials worry that relaxing restrictions would threaten American national security interests. But such worry is unnecessary. As a developing country, China has a stake

Japan outsells the U.S. in China

Leading U.S. electronics exports to China in 1986

($ millions)

Digital automatic data-processing equipment	$97.171
Professional, scientific and test equipment	$72.980
Machines and parts for the production and assembly of semiconductor devices, diodes, transistors and integrated circuits	$62.987
Central-processing units	$49.085
ICs and other components	$23.249

Sources: U.S. Commerce Department, National Council for U.S.-China Trade

Leading Japanese electronics exports to China in 1986

($ millions)

Telecommunications and sound recording and reproducing equipment	$771.964
Electrical machinery, apparatus and appliances	$589.116
Professional scientific and controlling instruments	$332.548
Office machines and automatic data-processing equipment	$159.616

Source: Chinese government statistics

in a prolonged environment of international peace — in order to build itself into a modern, industrialized nation. Our goal is to quadruple the 1980 gross national output value of industry and agriculture by the year 2000. And that is the reason why, in recent years, China has introduced advanced electronics technology, production equipment, and computer systems from developed countries, to upgrade its existing electronics enterprises, improve its production standards and meet the requirements of its scientific research, education and modern management.

There exists a mutual need to develop Sino-U.S. trade and technical cooperation in the electronics industry

All of these electronics imports play a vital role in raising the technical level of Chinese industry and accelerating the growth of our national economy. China will not infringe upon the safety and interests of any country; on the contrary, China is an important force in the world in maintaining world peace. In fact, a rich, strong and prosperous China will help maintain a peaceful and stable world.

Still, other U.S. government officials worry that China will resell advanced U.S. technology to a third country. The Chinese say that is impossible, because what China imports is only for expanding its own production, not for making money. China hopes to establish long-range, stable, cooperative relationships with all countries, including the United States. This is not an expedient measure. China has imported quite a number of high-tech items from industrialized nations. To protect its foreign partners' economic interests, China strictly protects the foreign partners' technical patent rights according to the contracts signed between them. China has formulated many economic laws, regulations and decrees to protect foreign technology property and will further strengthen these rulings. China abides by contracts and keeps its word. This is recognized by foreign firms the world over.

There exists a mutual need to develop Sino-U.S. trade and technical cooperation in the electronics industry. With the fast development of science and technology, technology is being further renovated; the production and processing of electronics products need more sophisticated technology; and new materials and new products are multiplying. Today, no one country in the world is capable of producing all the goods it needs, or owning all natural resources and all advanced technology. Hence, it is beneficial, to both China and the U.S., to cooperate in the field of electronics on the basis of equality and mutual benefit.

Although the technical level of China's electronics industry has risen over the last few years, it still lags behind that of the developed countries. Our industry's primary task, therefore, is to seek technology, especially advanced high technology, suited to China's basic conditions. This includes: large-scale integrated circuits, telecommunications, computers and software. China will offer preferential terms to foreign firms doing business with China in the field of electronics high technology.

Chinese electronics enterprises and end users prefer U.S.-made technology and products. We are interested in cooperating with both large and small companies. China is willing to adopt such cooperative forms as joint ventures, joint development, coproduction, technology transfer, compensation trade and manufacturing, using supplied materials.

Chinese electronics enterprises and end users prefer U.S.-made technology and products

If the U.S. government carries out a more flexible policy on technology sales to China, Sino-U.S. trade and cooperation in the electronics field will flower in the near future. At present, the international financial market provides a much more favorable climate for the United States to export technology and products. U.S. firms should seize this opportunity.

Xie, vice minister of China's electronics industry, oversees the Ministry of Electronics Industry's program for foreign trade and cooperation. He wrote this article especially for ELECTRONIC BUSINESS

Attention Manufacturing Consultants

ELECTRONIC BUSINESS magazine is preparing a directory of manufacturing consultants. We need your help to make sure the directory is timely and accurate. If you have been employed as a manufacturing consultant to one or more of the ELECTRONIC BUSINESS Top 200 electronic companies (see the July 15, 1987 issue of ELECTRONIC BUSINESS) please send us the following information on company letterhead. The deadline is October 15, 1987.

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To qualify, please send us the following information on company letterhead:

- Name
- Address
- Telephone
- Area of expertise
- Names of the ELECTRONIC BUSINESS 200 companies you have worked for since January 1, 1985.

(NOTE: For verification, please include a contact and phone number at each of the ELECTRONIC BUSINESS 200 companies you have worked for.)

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